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Report of the Chief

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Bureau of Biological Survey

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UNITED STATES DEPARTMENT OF THE INTERIOR

Harold L. Ickes, Secretary

BUREAU OF BIOLOGICAL SURVEY

Ira N. Gabrielson, Chief

[Report of the Chief of the Bureau of Biological Survey, 1940, reprinted from the Annual Report of the Secretary of the Interior, 1940, pp. 223—290]

CONTENTS

	Page
Introduction	223
Organization changes	225
Other events of the year	225
Dissemination of wildlife information	228
Funds available	229
Research on wildlife status and management	229
The waterfowl situation	229
Other migratory game birds	232
Banding game and other birds	233
Wildlife relationships to forest and range	235
Biological investigations on wildlife refuges	236
Wildlife-management research	237
State biological surveys and faunal studies	239
Economic research on wildlife	240
Waterfowl-management investigations	240
Mosquito control in wildlife habitat	242
Laboratory research on food habits	243
Cooperative food habits research	243
New food habits laboratory at Patuxent Research Refuge	244
Studies of nutrition and physiology of upland game birds	245
Studies of injurious birds	245
Research in the control of harmful mammals	247
Fur-animal conservation and restoration	248
Fur production and the fur trade	248
Cooperative investigations	249
Fur Animal Experiment Station, New York	251
Rabbit Experiment Station, California	251
Fur Animal Field Station, Maryland	252
Wildlife-disease research	252
Fur-animal disease control	252
Wildlife-disease research—Continued.	
Game-bird diseases	253
Physical properties of quail feeds studied	253
Infectious diseases in big game	253
Research on national park wildlife	254
Wildlife relationships	254
Range-improvement studies	255
Biological surveys and wildlife inventories	256
Federal aid in wildlife restoration	256
Acquisition of land for refuges	261
The national wildlife refuge program	265
Administration and management of refuges	265
Development of refuges	269
Public use of refuges	274
Administration of wildlife conservation laws	275
Regulatory action	276
Work of game-management agents	276
Importation and other permits issued	279
Regulations	279
Species excluded	279
Species entered under permit	279
Permits under the Migratory Bird Treaty Act	281
Cooperative control of injurious animals	282
Predatory-animal control	282
Rodent control	285
Wildlife conservation in Alaska	287
Changes in regulations	287
Law enforcement	288
Wildlife restocking projects	288
Predator control	289
Biological investigations	289
Alaskan big game	289

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BUREAU OF BIOLOGICAL SURVEY [1]

Ira N. Gabrielson, *Chief*

INTRODUCTION

WILDLIFE in the United States was in a much better condition with reference to human requirements at the end of the fiscal year 1940 than at the beginning. For a bureau charged with the responsibility of national wildlife administration this satisfactory report would in most years be self-sufficient evidence that the agency was contributing to the national welfare. At a time, however, when nearly all undertakings are being judged in terms of defense against external aggression and internal subversion and when past experience indicates the need for caution against a perversion of patriotic zeal that may even endanger some of the important endowments of what must be defended, a more explicit evaluation of wildlife-restoration progress in terms of social welfare and national solidarity seems essential. In other words, it should be pointed out that the United States is better able to undertake an intensive national-defense program because of the success thus far achieved in restoring and conserving its wildlife and, further, that a continuing wise administration of this natural resource will strengthen a nation's defense against both foreign and domestic dangers.

Conservation—or prudent use—of wildlife is one way of making a country worth living in, a first essential in inspiring zealous defense. An abundant wildlife, in other words, is an added attraction to the outdoors, and outdoor experiences foster the qualities of character that are reflected in the American way of living, a heritage that must be defended. Thus wildlife conservation not only contributes toward defense against subversive tendencies but also develops a national morale that will withstand the stress of any emergency requiring action against forces from without.

Though intangible, this fundamental contribution is continuous and thorough rather than temporary or sporadic. Inconspicuous at any

[1] The fifty-fifth annual report of this organization is both its first to the Secretary of the Interior and its last as the Bureau of Biological Survey; in accordance with the President's Reorganization Plan No. II the Survey was transferred from the Department of Agriculture to the Department of the Interior on July 1, 1939; and by Reorganization Plan No. III it was merged with the Bureau of Fisheries on June 30, 1940, to form the Fish and Wildlife Service.

given time and perhaps even overlooked by many during emergencies, the benefits of wildlife conservation are long-time benefits. They will be as important in future requirements for good living and future national emergencies as they are at present. If a high type of conservation is not maintained consistently, the Nation may suffer losses that will be difficult to make up and will impair good living for many years thereafter. Conservation of wildlife in the United States would not in any presently conceivable emergency be consistent with any unusual inroads into the resource, either for meat supplies or for protection against theoretically serious crop losses.

The Biological Survey in administering wildlife has not only encouraged desirable birds and mammals but for many years has also taken the leadership in an intelligent restraint of the numbers of such species as do damage. Carnivorous animals that prey on livestock, rodents that destroy crops or food supplies, carry disease, and by their burrows damage irrigation and other embankments, and birds that prove destructive in orchards and grainfields are being controlled more effectively than ever before as a result of the operations and demonstrations of the Survey. These activities will take on new significance during a national emergency in which food supplies become of critical importance. They can be intensified to any needed degree, yet here too it will be important to exercise due caution, as World War experience indicates that demands for unwise destruction of desirable birds may at such a time be made in the supposed interests of food production. Control activities should never go beyond the demonstrated need.

Personnel and facilities of this agency will be available whenever needed by the Nation for a supreme effort. The field force throughout the country, which is unusually familiar with geographical features, in emergencies could protect areas where damage might impair transportation or weaken defenses. The well-organized and capable body of men engaged in enforcing the Federal laws that protect wildlife could undoubtedly assist in anti-espionage and other under-cover work. Yet it seems important to emphasize that in general the greatest service that this agency can perform during a national emergency is to continue to conserve wildlife as an invaluable natural resource that is at all times essential to the national welfare.

Wildlife conditions in the United States are not yet what they should be everywhere. Those that are favorable are the result of years of planning and carrying out corrective measures that were sorely needed after unwise exploitation. Only in recent years has there been a definite and well-implemented national program to restore and conserve wildlife. In the 55 years since its beginning as a

small unit of three employees concerned with research in economic ornithology, the Biological Survey at the time of its merger with the Bureau of Fisheries at the close of the year had developed into an action as well as a research agency and had become the instrument of a strong national purpose to administer wildlife resources intelligently. The final year of its separate existence was a climax of accomplishment, and its enlarged opportunities as part of the Fish and Wildlife Service are faced with confidence and enthusiasm.

ORGANIZATION CHANGES

The fiscal year 1940 was characterized largely by efforts to improve efficiency by perfecting governmental organization for carrying on conservation activities, the actual work being in the main a continuation of programs already under way looking toward the ultimate objective of sound wildlife restoration. On the first day of the fiscal year the Biological Survey became a part of the Department of the Interior, entering into closer cooperation with other agencies of the Department, including the Bureau of Fisheries, which had simultaneously been transferred to it from the Department of Commerce. A continuance of cooperation with agencies of the Department of Agriculture on matters related to wildlife was agreed to by a formal memorandum.

During the course of the fiscal year the Food Habits research laboratory, after 55 years in Washington, D. C., was transferred to new quarters at the Patuxent Wildlife Research Refuge, Md. Under authority of Reorganization Plan No. II, the Secretary directed the transfer of the Wildlife Division of the National Park Service to the Biological Survey, which became effective on January 1, 1940. Plans also were completed for a reorganization of field work in the United States, the nine regions being rearranged into five. On the last day of the year, in accordance with the President's Reorganization Plan No. III, the consolidation of the Biological Survey and the Bureau of Fisheries to form the Fish and Wildlife Service became effective. Through these changes the Federal Government enters the fiscal year 1941 better organized than ever before to carry on the work of wildlife restoration.

OTHER EVENTS OF THE YEAR

The outstanding events of the year in connection with programs and policies already under way may be summarized as follows:

Research on Game Birds

Canada goose studies.—Investigations of Canada geese and the factors influencing their increase were conducted in Utah, Oregon, and

California, and studies of their feeding habits were made in the Great Basin and in the Northwest.

Experiments in marsh burning.—On the Sabine and Lacassine Refuges, La., experimental burning of marshes indicated that fire is an important tool in management for geese, as an estimated 500,000 geese were attracted to these refuges after the burning.

Industrial operations in wildlife habitat.—Studies were made of wildlife problems on the Santee-Cooper Power and Navigation Project in South Carolina for safeguarding a major winter-concentration area for waterfowl and an ideal river-bottom and forest habitat for one of the purest strains of wild turkey in eastern North America.

Mosquito control and waterfowl habitat.—A detailed experimental project was set up at the Bombay Hook Refuge, Del., and gratifying results were obtained in demonstrating control of salt-marsh mosquitoes with minimum injury to waterfowl habitat.

Quail-nutrition studies.—In investigations on bobwhites, the nutritive value and palatability of several native quail foods were studied and it was developed that common salt is a valuable aid in combating cannibalism among both growing and adult birds.

Fur-Production Investigations

Disposal of Federal furs.—A unified policy was established for handling and disposing of all furs that become the property of the Bureau.

Import quota on foxes.—Largely through cooperation with fur farmers and Federal agencies, an import quota on silver foxes was established, thus preventing the dumping of foreign pelts on the American market and serving to maintain prices paid for silver fox pelts.

Exceptional prices for pelts.—Of unusual interest was the sale of a single Norwegian platinum fox pelt for $11,000 and an entire lot of 400 platinum skins for more than $500 each.

Other Wildlife Studies

New laboratories at Research Refuge.—Completion of the C. Hart Merriam Laboratory (named for the first chief of this agency) made available a three-story structure to house the former in-Washington staff of the Food Habits laboratory, and doubling the size of the Henry W. Henshaw Laboratory (named for the second chief) provided needed facilities for wildlife-disease research. These laboratories and a 3,000-acre wood and cultivated tract make extensive research possible on wildlife problems peculiar to the Eastern States.

Completed catalog of type specimens.—A list with data of the 1,323 mammal type specimens in the Biological Survey collection was completed for publication by the United States National Museum.

Research on elk.—A 10-year research on the American elk was completed, and the manuscript reporting it submitted for publication in the North American Fauna series.

Classification of white-tailed deer.—Research in cooperation with the National Museum on the classification and distribution in North and Middle America of the white-tailed deer, the most important American big-game animal, was completed, and 10 new forms were described.

Discovery of vanishing deer.—A herd of between 500 and 1,000 Pacific white-tailed deer, a subspecies previously supposed to be near extirpation, was discovered and studied.

Marsh-ecology research.—Research conducted during the past two years on the ecology of the marshes and swamps of the Gulf region resulted in the preparation of a technical report on alluvial marshes and swamps of Louisiana.

Refuge food and cover studies.—Surveys of wildlife refuges were made to note the relation of native and propagated food and cover plants and animal communities and populations to wildlife welfare and refuge management.

Control methods.—Research developed more effective and selective methods for use in the control of predatory animals and injurious rodents, improved the practices for controlling tree-girdling mice in the Northeastern States, and perfected a method to concentrate the active principle of red squill used in rat control.

Wildlife Restoration

Effectiveness of Federal-aid program.—Experience gained during the first year's Federal aid in wildlife restoration and increased funds enabled the States to undertake wildlife restoration activities more effectively and more extensively, 237 individual projects involving the expenditure of $2,082,735 having been begun as compared with 58, at a cost of $343,932, initiated in 1939.

New refuges.—The number of wildlife refuges was increased to 263 and the acreage to 13,635,365; the 3 new refuges were the Susquehanna, Md. (a closed area); the Noxubee, Miss.; and the Bosque del Apache, N. Mex.

Refuges placed under administration.—Eight regular refuges, totaling 1,617,993 acres, were placed under active administration, and 68 easement areas in North Dakota and 4 in Montana were assigned to nearby refuges for administration.

Drainage projects inspected.—Of 202 proposed W. P. A. drainage projects inspected, 150 were approved by the Bureau, 15 disapproved because of adverse effects on wildlife, and 37 approved conditionally.

Refuge revenue.—Income from the sale of surplus big-game animals and other refuge products and for the use of refuge lands totaled $75,845, of which 25 percent was turned over to the counties in which the refuges are situated and the remainder deposited in the Federal Treasury.

Wildlife increases on refuges.—For the fourth consecutive year, increases were noted all over the country in the wildlife populations using the national wildlife refuges.

Pest Control

Bird damage to crops.—Marked progress was made in determining essential facts regarding damage by certain birds to crops and in working out improved methods and practices for prevention.

Predatory animals.—In safeguarding the Nation's wool and meat supply by protecting livestock, poultry, and game, 116,805 predatory animals were taken in organized control work.

Injurious rodents.—Protection was afforded to agricultural crops, forage and timber resources, soil-conserving structures, and stored food supplies through the treatment under Bureau supervision of 12,174,125 acres infested by injurious rodents and 198,902 premises in rat control.

DISSEMINATION OF WILDLIFE INFORMATION

When transferred from the Department of Agriculture on July 1, 1939, the Bureau ceased to contribute to the various publication series of that Department, other than statistics of hunting stamps and licenses, but continued to disseminate information on wildlife research, conservation, and management in several series of the Department of the Interior, some of them new. Technical reports continue to be issued in the North American Fauna and in a new series of Wildlife Research Bulletins. Popular publications formerly appearing in the Farmers' Bulletin series are now contributed to a new series of Conservation Bulletins of the Department of the Interior and have the same aid of Congressional distribution as was formerly given the Farmers' Bulletins. All other Bureau publications are consolidated in one series of Wildlife Circulars, except posters, annual reports, brief processed Wildlife Leaflets, and the Alaska Game Commission Circulars, which, not being numbered departmental series, remain unchanged.

Continuing other functions of disseminating wildlife information, the Bureau prepared summaries of its findings and announcements of important events for release to the press, and met many demands for special articles in periodicals and for addresses at conventions and meetings. In the radio field it participated in the preparation of national network wildlife programs and assisted in the preparation of a series of 15-minute transcribed radio programs for use by local stations.

To disseminate information through motion pictures it produced three one-reel sound pictures, in both 35-mm. and 16-mm. sizes, on mice in orchards and bears in Alaska; and furnished photographs to writers and publishers for illustrating wildlife-information articles.

The Bureau participated more extensively than previously in the observance of National Wildlife Week, and again took an active part in planning and participating in the North American Wildlife Conference. Members of the technical staff represented the Bureau at other gatherings of scientists and conservationists, and of stockmen, farmers, and others interested in various phases of wildlife research and management, where they had opportunity to present in detail many matters here briefly summarized.

FUNDS AVAILABLE

To finance the work of the Survey for the year a total of $7,392,524 was available from regular and emergency appropriations. Of this sum, $3,928,691 was carried in the Agricultural Appropriation Act for regular activities; $1,111,325 was realized from the sale of Federal migratory-waterfowl hunting stamps; $820,798 was allocated from the Emergency Relief Appropriation Act of 1939 for water-conservation and wildlife-restoration work, and $34,216 for related administrative expenses; $1,293,644 was made available for expenditure in connection with work performed by the C. C. C. on national wildlife refuges; and $203,850 was allocated by the Public Works Administration for the construction of buildings and other improvements at the Fur Animal Experiment Station, Saratoga Springs, N. Y., and on the Patuxent (Md.) Research Refuge.

RESEARCH ON WILDLIFE STATUS AND MANAGEMENT

THE WATERFOWL SITUATION

Investigations in Canada

Study of the migration of waterfowl in the spring of 1939 substantiated the general accuracy of the preceding January inventory. Nearly 300 carefully picked observers covered the movement and 71

percent noted increased numbers of the birds, compared with the spring flight of 1938. Assured thus of a larger breeding stock, the biologists of the Atlantic, Mississippi, and Central Flyways resumed their investigations on the nesting grounds of Canada, carrying on work in the eastern Maritime Provinces, the eastern Arctic, and the central region, from the international boundary to the Arctic coast. The vast breeding grounds "north of the bush" in central Canada have not been altered by human activity and are found today as satisfactory for nesting waterfowl as when first seen by civilized man. With an adequate stock of birds to populate them fully, they could probably supply, without recruitment from other regions, most of the ducks and geese that at present can be carried through the winter. The evidence demonstrated that the waterfowl population is on an upward trend.

Waterfowl habitats in south-central Canada have been materially improved by the development of small water areas under a program sponsored by the Dominion Government by the passage in 1935 of the Prairie Farms Rehabilitation Act. Appropriations for this purpose totaled $1,250,000 in 1935, $1,184,420 in 1936, and $2,000,000 in 1937, the last year for which figures are available. By July 1939 the Dominion had completed 5,538 "dugouts," 2,388 stock-watering dams, and 568 irrigation projects, a total of 8,494, in addition to more than 200 larger, municipal-community projects. Although only a few of these areas are yet suited to the needs of nesting waterfowl, some were immediately adopted by the birds.

Investigations in Alaska

Indications are that the waterfowl breeding grounds of Alaska are the source of most of the ducks and geese seen in California and other Pacific coast sections, but their great importance has not been fully recognized. The Pacific Flyway biologist made studies of Alaska waterfowl populations and habitats in the valleys of the Yukon, Kuskokwim, Tanana, Innoko, and Iditarod, as well as in those of other rivers of lesser importance, and at the conclusion of work in the twin Yukon and Kuskokwim Deltas, made a reconnaissance north to the delta of the Noatak River, tributary to Kotzebue Sound. The summary of his own observations and of reports of the agents of the Alaska Game Commission and others pointed to a distinct numerical improvement in the geese, swans, and cranes, and indicated that, while the duck population was satisfactory, there were no conspicuous gains over 1938.

Investigations in Mexico

The Central Flyway biologist resumed his winter investigation on the east coast of Mexico south to the head of the Tamiahua Lagoon, while the biologist of the Pacific Flyway was working in the western part of that country from Chihuahua and Coahuila south to Morelos and Guerrero. Although serious drought in eastern Mexico had lowered the levels of coastal lagoons, leaving scores of square miles of mud flats covered with dried aquatic vegetation, the ducks appeared to have no difficulty in finding suitable quarters. The total number wintering in eastern Mexico showed a slight increase over 1938–39, despite varying decreases in the gadwall and the baldpate. Geese in general were present in smaller numbers, but probably at least 5,000,000 waterfowl of all kinds wintered in eastern Mexico. The duck population of the tableland and coastal areas of western Mexico, however, was materially lower than in 1938–39. The season was abnormal, investigations in California, made both before and after the Mexican operations, indicating that large groups of the Pacific Flyway waterfowl had wintered north of the international border.

Investigations in the United States

A greater spring run-off improved nesting conditions on the Federal refuges in the northern plains and increased their production of waterfowl. The extent of the increase is indicated by an estimate of 250,000 ducklings on the Lower Souris Refuge, N. Dak., compared with 40,000 for 1938, and of similar gains on other refuges. It was noteworthy that in several cases the species affected were among those that only a few years ago were considered to be in a precarious condition, among them the redhead, canvasback, and ruddy duck. The Canada goose also made important local gains.

The fall migration was characterized by a delayed movement of the birds. Storms and freezing temperatures came much later than usual, and when winter closed in quickly the waterfowl passed so rapidly through some sections that they were all but unobserved, particularly where there was a shortage of water. The Bureau's volunteer observers, however, submitted more than 500 reports, and considering the abnormal weather, which unquestionably affected the observations, these showed a satisfactory condition of the birds.

The biologists of the Mississippi and Atlantic Flyways devoted the winter to studies of the usual concentrations of ducks and geese in the lower Mississippi Valley and on the south Atlantic coast, the chief wintering grounds for these two flyways, and noted a gratifying increase in both ducks and geese. Supplementing the results

were weekly or monthly reports from refuge managers, game-management agents, and other field officers, the regularity of which kept information current on the movements of the birds and of the conditions affecting them.

Large flocks of ducks from the Atlantic Flyway may cross the Straits of Florida to winter in extensive swamps and at the heads of bays in Cuba, and it is known that some continue eastward to wintering grounds on the island of Hispaniola. This flight is the least known of any included in the flyway system and points to the need of winter investigations in the Greater Antilles. There is no known or suspected important wintering ground of the Mississippi Flyway south of the United States.

The sixth consecutive January inventory was conducted by between 2,000 and 3,000 persons under exceptionally trying conditions, but the results completely vindicated the methods employed. Despite freezing weather extending to the Gulf coast, and prevalent deep snows, the operation was carried out on schedule. Practically the entire field force of the Bureau was utilized, together with personnel of other Federal and State agencies, and aircraft of the Army, Navy, and Coast Guard and of a commercial tire and rubber company. The results indicated that there were about 65,000,000 ducks and geese on the North American Continent at that time in contrast to the low of 27,000,000 estimated for January 1935.

OTHER MIGRATORY GAME BIRDS

In the winter, most of the woodcocks of the continent gather in Louisiana and western Mississippi and the mourning doves of eastern North America concentrate heavily in the Southeastern States. Investigations in January showed that both species suffered serious losses because of abnormally cold weather. A later Nation-wide study showed that both species had been reduced materially in numbers, the woodcock as much as 40 percent in some areas. Appropriate safeguarding action was accordingly taken. A study of the Wilson's snipe showed that it too was affected, but its wider range made the results less menacing.

Studies of the western white-winged dove have been made in Arizona for 3 years, and this year the investigation was extended to include the eastern form in the Rio Grande Valley in Texas. Although the latter study is too new to serve as a basis for administrative action, the indications are that these doves are being heavily overshot in both regions. Regulatory action has been taken to reduce the kill in Arizona and probably must also be done in Texas. It

seems questionable whether this bird can continue to be used as a game species unless the conditions affecting its welfare can be improved.

A detailed report on the status of all migratory game birds, as revealed by the year's investigations, was issued in June as Wildlife Leaflet 165 (processed).

BANDING GAME AND OTHER BIRDS

Work on Federal Refuges

The refuge and other Bureau personnel are now so favorably located that they will be able to band most of the ducks and geese necessary for the continuation of these studies, though a few stations operated by volunteer cooperators are still of primary importance because of the volume of work done. The birds banded on Federal refuges totaled 58,852, an increase of more than 22,000 over 1939. Reports on refuges banding more than 1,000 each are as follows:

Refuge:	*Number*	Refuge:	*Number*
Sand Lake, S. Dak	17,339	Klamath Lake, Oreg., and Clear Lake and Tule Lake, Calif	2,305
Des Lacs, N. Dak	8,481	Lower Souris, N. Dak	2,298
Bear River, Utah	5,534	Sacramento, Calif	2,072
Malheur, Oreg	5,502	Medicine Lake, Mont	1,711
Chautauqua, Ill	4,089	Waubay, S. Dak	1,288
Piedmont, Ga	3,212	Cape Romain, S. C	1,012

As opportunities offered, game-management agents, field biologists, and other Bureau employees banded an additional 6,575 birds, bringing the grand total banded by them to 65,427.

Bird-banding Cooperators

To weed out cooperators who had become inactive or had never participated actively in bird-banding work, and to permit the addition of promising new station operators, a drastic revision of the list was in progress at the close of the year. Seven cooperative stations each reported the banding of more than 5,000 birds, as follows: E. A. McIlhenny, Avery Island, La., 28,909; O. L. Austin, North Eastham, Mass., 22,426; C. M. Owens, Monticello, Ark., 12,737; C. C. and F. E. Ludwig, Lansing, Mich., 8,377; G. C. Munro, Honolulu, Hawaii, 7,321; Hugh S. Davis, Tulsa, Okla., 5,670; and Geo. H. Lowery, University, La., 5,420. The work at Avery Island was particularly remarkable, as it included thousands of waterfowl of several species, hundreds of vultures and herons, and a large variety of small nongame birds.

Additional Birds Banded

Birds to the number of 428,185 were reported banded, bringing the total since 1920 to 3,712,327. Species banded in excess of 10,000 were the mallard, 40,046; chimney swift, 38,821; common tern, 24,318; pintail, 21,506; junco, 21,399; white-throated sparrow, 21,147; herring gull, 15,911; grackle, 11,844; and starling, 10,324. For the first time a species of waterfowl headed the list. Additional species of waterfowl banded in excess of 1,000 were the ring-necked duck, 4,560; green-winged teal, 4,524; blue-winged teal, 3,553; baldpate, 2,328; and Canada goose, 1,931. In all, 478 species of birds were banded, the following 9 for the first time: Rhinoceros auklet, Audubon's shearwater, black oystercatcher, sage hen, Mississippi kite, spotted owl, and rufous-crowned sparrow, and in Hawaii the small gray tern and the Phoenix Island shearwater. Records of waterfowl banded in 1939 and 1940 are shown in table 1.

TABLE 1.—Waterfowl Banded During the Fiscal Years 1939 and 1940

Species	1939	1940	Species	1939	1940
	Number	*Number*		*Number*	*Number*
American merganser	32	12	Greater scaup	914	27
Red-breasted merganser	1	4	Lesser scaup	5,290	1,958
Hooded merganser	14	12	Ring-necked duck	1,953	4,560
Mallard:			American goldeneye	10	8
Wild	15,751	37,969	Barrow's goldeneye	1	
Hand-reared	981	2,077	Bufflehead	18	6
Black, cross	20	19	Old squaw		4
Black duck:			Harlequin duck		3
Wild	8,653	9,889	American eider	4	1
Hand-reared	1,554	98	White-winged scoter	23	1
Florida duck	86	27	Ruddy duck	41	69
Gadwall	781	505	Snow goose	4	12
Baldpate	1,449	2,328	Blue goose	16	92
Green-winged teal	1,721	4,524	White-fronted goose	8	52
Blue-winged teal	4,118	3,553	Canada goose:		
Cinnamon teal	379	188	Wild	1,163	1,815
Shoveler	582	714	Hand-reared	24	116
Pintail:			Emperor goose	1	
Wild	18,861	21,419	Fulvous tree duck	1	1
Hand-reared	299	87	Whistling swan	7	1
Wood duck	414	686			
Redhead	629	557	Total	66,290	94,101
Canvasback	487	707			

Return and Recovery Records

The total number of new bandings shows a slight decrease from 1939, and the number of banded birds recaptured and reported increased by 5,018 (from 26,998 to 32,016). This is due largely to the greater number of banded ducks and geese at large, so many returns of which result from the hunting kill. Among the returns were records that not only extend the known ranges of the species but also contribute to the knowledge of the flyways and individual migration routes, migration speed, longevity, and other life history details. Reports on outstanding recovery records have been pub-

lished in the quarterly journal Bird-Banding, and an article on the winter range of the herring gull, based chiefly on banding data, has been prepared for publication in The Auk. Bird Banding Notes (vol. 3, no. 1, processed), containing details of the work during the year, was issued in October.

Distribution and Migration Records

Additions to the files on the distribution and migration of North American birds included 19,000 individual observations, together with 1,080 bibliographic cards and 860 locality references. Seasonal migration reports were received from 235 of the 342 observers now listed. Bird Migration Memorandum No. 5 (63 pp., processed) was issued in November, presenting by flyways a comparative analysis of the fall migrations of 1937 and 1938. Work has been completed on tables analyzing spring migration data from five stations in Florida, North Carolina, Pennsylvania, New York, and New Brunswick, three of which have made reports, almost without a break, since 1886. Distribution maps have been prepared for 26 species of sparrows, and available data have been analyzed for 6 others. Two wildlife leaflets, Birdbanding (No. 145) and Suggestions for Bird Field Study (No. 150), were revised and a new one, Original and Present Breeding Ranges of Certain Game Birds (No. 158) was issued. Distribution and migration sections covering the flycatchers and swallows, to be used in National Museum bulletins on the life history of North American birds, also have been prepared. Corresponding data were included in the volume issued toward the end of the year on the parrots, cuckoos, goatsuckers, hummingbirds, trogons, and related species.

WILDLIFE RELATIONSHIPS TO FOREST AND RANGE

Studies on the San Joaquin Range Experimental Station, Calif., indicate that pocket gopher burrowing actually increased the growth of forage but that the quantity of forage destroyed by these animals exceeded this increase. Methods have been developed to make accurate censuses of ground squirrels, the numbers of which seem to be kept down by intensive grazing though not affected by light to close grazing. Experiments are under way to determine the effects of rodents on soil erosion, porosity, and water percolations. The coyote-deer relationship study on the Los Padres National Forest was completed.

Investigations in New England on improving wildlife foods by planting trees and shrubs show that thrifty 2-year-old plants, top-pruned and properly spaced, were economical in establishing cover

islands and fringes adjacent to forest areas. Annual food patches are not needed in typical New England forests, and special plantings over large areas of food trees for wildlife alone are not justified. The shaping, pruning, and encouraging of the 10 common kinds of food trees and shrubs coming into natural stands seems to be the best means of managing these forests for wildlife.

A report on wild-animal damage to seed and seedlings on cut-over Douglas fir lands of Oregon and Washington is in press, and papers on the relationship of pocket gophers to mountain meadow ranges and the role of rabbits and mountain beavers in Douglas fir plantations have been completed.

Suggestions were made for managing white cedar yards for deer in the Lake States region. As a 12-inch cedar produces 74 pounds of browse and when felled is capable of feeding one deer in winter for about 16 days, it was recommended that cedar be logged late in winter—a critical time for deer.

Studies showed that the European starling (*Sturnus vulgaris*) is becoming a factor in longleaf pine reproduction in Mississippi. Examination of starling stomachs taken in areas where the seed was available disclosed them filled chiefly with pine seed.

BIOLOGICAL INVESTIGATIONS ON WILDLIFE REFUGES

A survey of forage conditions was continued on the Wichita Mountains Wildlife Refuge, Okla., to determine changes during the second year of freedom from livestock. Three-awn grasses, of little forage value and often injurious to grazing animals, grow abundantly over the refuge, most commonly where there has been overgrazing. A browse study plot was established in an area containing growths of sumac, to determine the effect of herbaceous ground cover on the growth and spread of this shrub, as it appears that sumac may be an indicator of overgrazing on some soil types, coming in after the herbaceous cover has been depleted. Mimeographed lists of the mammals, birds, reptiles, and amphibians of the refuge were compiled for distribution.

Studies were begun on the range requirements of antelopes on the Charles Sheldon Antelope Refuge and Range, Nev., and on the Hart Mountain Antelope Refuge, Oreg., with a view to determining the carrying capacity of these areas for antelopes and mule deer and the grazing by domestic stock that can be permitted on the Charles Sheldon tracts. Good progress has been made in this work, which will be extended to include a complete cover-type survey and range map of the areas.

Progressive experiments and observations have been made on the Cape Romain Refuge, S. C., toward the development of Bull Island for wild turkeys. This work, carried on for 2 years, has now been completed as a special project, though work will be continued in a limited way as a study for improving food and cover relationships and for establishing breeding stock of native wild turkeys of pure strain.

WILDLIFE MANAGEMENT RESEARCH

Cooperative Research Units

A 5-year program of basic research on wildlife management problems, carried on at 10 land-grant colleges, has been completed and a second 5-year plan drawn up to obtain information on the best methods to be used in wildlife restoration and management, to demonstrate management practices on large areas, and to provide special training in wildlife work for advanced students. The 10 units were cooperatively financed by the State game and conservation commissions, land-grant colleges, the American Wildlife Institute, and the Bureau of Biological Survey. Advanced degrees were received by 27 students, who completed research on assigned problems. Following were the principal activities of the units:

Maine.—Techniques have been developed for censusing woodcock through counting occupied singing grounds and nests and counting the broods with the aid of dogs trained to locate the birds. Through pen studies snowshoe hares were found to breed the same day young are dropped, the gestation period averaging 36 to 37 days. Factors in the mortality of young rabbits included destruction by the mother, cannibalism, predators, and wandering away. Other work included aquatic plantings in many lakes and studies of deer and moose and of silvicultural methods in relation to wildlife.

Pennsylvania.—The comparative attractiveness to wildlife of two forest areas of different types in Centre County, one of 7,000 and the other of 9,000 acres, was studied. In the barrens, where there was an abundance of browse and mast, ruffed grouse and turkeys were plentiful, and there was one deer to 18 acres. In the Seven Mountains region, where the forest is composed of aged hardwoods with little understory, the grouse were scarce, turkeys plentiful, and there was one deer to 116 acres. Studies were made also of pheasants, ruffed grouse, woodcocks, black bears, and cottontails.

Ohio.—Management practices for fox squirrels were determined and tested in farm wood lots. Land-use factors affecting pheasant production and the value of a refuge system were worked out. Conclusions from red-fox studies indicated that year-round hunting is removing the annual surplus, that the present abundance does not call for control measures, that where poultry is kept from wooded areas in spring, no losses have resulted, and that the average population of foxes is 1.5 per square mile. Studies on raccoons showed a population of 1.12 for each mile of permanent stream or 2.58 per square mile.

Virginia.—Using mass-production methods, 900 wild turkey poults were raised. In one release of 34 birds, 23 survived the first year. Studies showed that the

situation of gobbling areas may influence the utilization of nesting sites in natural range. More than 470 turkey crops, representing all months, were examined. Quails, ruffed grouse, deer, and elk were also featured in the research program.

Alabama.—A 16-mm. color film, Nesting Cycle of the Mourning Dove, was prepared and shown to audiences in several States. Information on management practices was obtained from 450 quail-food plots, as to growth, yield, availability, planting seasons, propagation methods, pests, and diseases. Data from 359 fox stomachs and 32 dens indicated that the major food items of these animals are rabbits and insects, there being little evidence of quail destruction.

Missouri.—Studies of cottontail rabbits revealed an annual average of 3.8 litters per female, of 4.4 young per litter, and of 16.7 young per female. Research into the management of field borders in relation to agriculture and wildlife revealed that (1) bird populations varied in proportion to the density of edge growth; (2) birds were a factor in limiting insect populations; (3) birds seemed to take more harmful than beneficial insects; and (4) field edge growth was of value in protecting crops from destructive insects. Observations on deer showed that 60 species of plants were utilized as food late in summer and in fall and 70 species of woody vegetation in winter. Yields of these foods in post oak forests were 84 pounds per acre in sapling stands, 147 pounds in pole stands, and 128 pounds in merchantable stands. Management practices for quail included restriction of the kill, planting of food patches, and reduction in burning, grazing, and clean-up activities, resulting in an increase in quail on a 5,000-acre area from 996 in 1937 to 2,778 in 1939. Studies were made also of chukar partridges and prairie chickens. Although 165,000 live rabbits were shipped to 20 States during the year, a winter census revealed no depletion in the local rabbit population.

Iowa.—A 5-year study in quail management on two agricultural areas showed that three severe winters accounted for 87, 74, and 55 percent losses, with midwinter starvation, clean-harvested cornfields, and a high rate of predation as important factors. For nesting, redhead ducks were found to require small pot holes of 5 to 20 acres and open water within 150 feet of the nest. Studies yielded valuable information also on ring-necked pheasants, mourning doves, raccoons, cottontails, foxes, skunks, and fox squirrels.

Texas.—In central Texas, observations on quail headquarter areas, having brush-and-pole shelters and food patches, showed 75 percent occupied and in the coastal prairie region 63 percent. Studies on prairie chickens showed that the limiting factors were land cultivation, pasture burning, May rains, overshooting, heavy grazing, and development of oil fields, drainage canals, and roads. Three county wildlife surveys and a study of relation of land-use practices to wildlife in eastern Texas were completed. Reports for the agricultural-extension program showed that 25,000 farm people in 207 counties cooperated in aiding wildlife on 27,000,000 acres.

Utah.—Observations on sharp-tailed grouse in 16 areas having a population of 1,000 birds showed that of 106 nests, 40 hatched, and 66 were destroyed by farming, and that 83 percent in native-grass vegetation were successful, and in cultivated fields 27 percent. In 1940, 47 broods averaged 10 birds each. Sage grouse studies at the DuBois Sheep Experiment Station (Idaho) revealed that of 132 nests, 51.5 percent were successful, and that of the nests lost, 38.8 percent were destroyed by livestock, 22.2 by crows, 22.2 by coyotes, 5.5 by weasels, and 11.3 percent by unknown agents. Other studies involved deer, elk, and beavers.

Oregon.—Studies on ring-necked pheasants on Protection Island (Washington) indicated that where 10 cocks and 6 hens had been released in 1937 under

natural conditions, there were, in 1940, 185 cocks and 97 hens. Records for the Willamette Valley in 1936 showed 1 game bird to 77 acres, and in 1940, 1 bird to 10 acres. One demonstration management area, without restocking, beginning with 1 bird per 100 acres in 1936, harbored a population in 1940 of 16 birds per 100 acres. Studies were completed on the antelope and sage grouse and on mule deer problem areas.

STATE BIOLOGICAL SURVEYS AND FAUNAL STUDIES

Preparation of the report on the mammals of Arizona was resumed near the close of the year. Work was continued on the mammals of Florida, and the report almost finished. A revision of the raccoons was brought nearly to completion. Research on the life history, economic status, classification, and distribution of the wolves of North America advanced, and the results are now being arranged for publication. A manuscript on the American elk was completed.

Investigations on the life zones and mammals of Washington, begun several years ago, continued with progress. A comprehensive work entitled "Birds of Oregon" (650 pp., illus.), under the authorship of the Chief of the Biological Survey and Stanley G. Jewett, regional biologist, was published in April by the Oregon State College, thus making available to the public the results of information on the bird life of the State. A manuscript on the extensive study of the birds of Texas should be ready for printing by the end of the calendar year. In an intensive study of the marten in Idaho particular emphasis was placed on its relation to other animals and on trapping. This animal is generally considered a vanishing species, and the study indicates that the chief cause of its scarcity is overtrapping.

Research on the wild turkey has shown that the effects of civilization are to extirpate the species where suitable management is not applied. At no place is the bird increasing in numbers or even holding its own in the absence of such objective management. The principal factor in its decrease is a hunting take, both legal and illegal, in excess of the annual increment above breeding populations. Other factors are natural enemies, unfavorable changes in range ecology, disease, deforestation, industrialism, and human influences in the vicinity of its range, drainage, fire, overgrazing by domestic stock, and interbreeding with domestic varieties.

The study collections of mammals, birds, and other vertebrates continue to be essential both for the Bureau's research work and as a basis for administrative operations. Continued progress has been made in recording information based on collections, reports, and publications and in preparing reports on relationships, distribution, and habits of species. During the year 624 mammal specimens were

added to the collection, 1,191 were identified for 30 institutions and individuals in 27 States and 1 foreign country, 92 were borrowed for study from 3 institutions in 3 States, and 591 were loaned to 13 institutions and individuals in 11 States. Bird specimens to the number of 1,536 were added to the collection, 859 were identified for 35 institutions and individuals in 20 States and 1 foreign country, and 358 were loaned to 19 institutions and individuals in 11 States and 1 foreign country.

Bureau biologists described 27 new mammals belonging to the genera *Dipodomys*, *Odocoileus*, *Onychomys*, *Neotoma*, *Perognathus*, *Peromyscus*, *Reithrodontomys*, *Scalopus*, *Sylvilagus*, and *Taxidea*. Type specimens in the mammal collection now number 1,325. The mammal laboratory was utilized by 130 research workers other than Bureau employees from 27 States and 1 foreign country. An account of the mammal collection was given in a Wildlife Leaflet (BS–153), and the following additional leaflets were issued relating to biological surveys and other work basic to wildlife conservation: Big-game Inventory of the United States, 1938 (BS–142), Raising Deer in Captivity (BS–144), Status of the American Bison in the United States and Alaska, 1939 (BS–148), and Suggested Action for Sportsman's Organizations (BS–152).

ECONOMIC RESEARCH ON WILDLIFE

WATERFOWL-MANAGEMENT INVESTIGATIONS

Waterfowl-Nesting Studies

As a basis for determining the factors affecting waterfowl production on national wildlife refuges, nesting studies were conducted on the following refuges: Crescent Lake, Nebr.; Bear River, Utah; Malheur, Oreg.; Lacreek, S. Dak.; Valentine, Nebr.; and Lower Souris, N. Dak. These indicated that depredations by bull snakes, skunks, ravens, magpies, and California gulls continued to be an important menace to the welfare of nesting waterfowl.

Ecological and Management Studies

In surveys made in Utah important factors limiting the production of aquatic vegetation were found to be salinity, turbidity, absence of organic muck, receding water levels, and the wave action caused by strong winds. Transplanting demonstrated the value of saltgrass (*Distichlis stricta*) and saltbush (*Atriplex hastata*) as cover plants for soils where high concentrations of soluble salts preclude most other growths, except foxtail (*Hordeum jubatum*), which has some objec-

tionable qualities. Duck-food plants found to have a wide salinity tolerance are hardstem bulrush (*Scirpus acutus*) and glasswort (*Salicornia rubra*).

Succession of vegetation on artificial banks over the past four years was correlated with nesting utilization by waterfowl, and it was learned that the pioneer stages were best suited to nesting. Studies showed that while artificial islands were not utilized by ducks and geese, 4 of these islands held 1,580 California gull, 14 cormorant, and 66 Caspian tern nests. Muskrats were found beneficial in making ponds in dense emergent growth, and on one area as high as 45 percent of all goose nests located during four years were on muskrat lodges.

A technical report on the alluvial marshes and swamps of Louisiana was prepared for publication. Experimental burning of marshes on the Sabine and Lacassine Refuges, La., indicated the importance of fire as a management tool. It was estimated that more than 500,000 geese used these burned areas. Livestock grazing prolonged the value of burns.

Management studies at the Malheur Refuge, Oreg., showed that giant burreed (*Sparganium eurycarpum*) was benefited rather than retarded by disking, that deep water impoundments favored the growth of hardstem bulrush (*Scirpus acutus*), and that mowing and grazing of wet meadows properly handled instead of noticeably hindering waterfowl breeding proved beneficial during fall, winter, and early spring by keeping the meadows open as foraging places for the birds.

Reconnaissance of Refuges and Refuge Sites

Reconnaissance was made of possible refuge sites in New England, particularly in Massachusetts, where past surveys showed the need for a major waterfowl area to round out the national wildlife refuge system along the Atlantic Flyway. Studies of wildlife problems were made on the Santee-Cooper power and navigation project, South Carolina; at Reelfoot Lake, Tenn.; on the Tobay Bird Sanctuary, N. Y.; in Shinnecock Bay, Long Island, N. Y.; in Ottawa and Lucas Counties, Ohio; in Mobile Bay, Ala.; in Pepin and Pierce Counties, Wis.; at Catahoula Lake, La.; on the Gilbertsville Reservoir, Tenn.; and on the Wheeler Refuge, Ala. With a view to assisting in the application of research findings in refuge development, surveys also were conducted on various other Federal refuges under the administration of the Bureau, including the following: White River, Ark.; Kentucky Woodlands, Ky.; Bombay Hook, Del.; Pea Island, N. C.; Noxubee, Ala.; and numerous other units.

Suppression of Waterchestnut

Studies to develop methods for suppressing the waterchestnut on the Potomac River were continued. Various chemicals and cutting devices were tried out in cooperation with the War Department and the C. C. C., and chemical tests were made with the assistance of a private industrial concern. The results of the mechanical control carried out last year were checked and found favorable, with only a minimum of follow-up work necessary. The job of completely eradicating the pest, however, becomes of greater magnitude each year. State authorities in New York were advised regarding waterchestnut control on the Mohawk River.

Canada Goose Management Studies

In Utah, Oregon, and California, studies of Canada geese and the factors influencing their increase were continued. A trap was designed and used in banding 1,263 wild geese on the Bear River Refuge, Utah, and a method of shipping the birds under adverse summer conditions was worked out. Experimental transplantings of young geese were made at four midwestern refuges and reports indicate that the birds will serve as nuclei for future breeding populations. Field studies were made of the feeding habits of geese in the Great Basin and in the Northwest.

Redhead Duck Management Studies

The tendency of redhead ducks to lay eggs in the nests of other birds was noted on the breeding grounds of the Bear River Refuge as an important contributing factor in the failure of the redhead population to recover promptly from disasters. In heavily shot-over habitats lead poisoning was found an important cause of mortality during certain seasons. Most of the redheads leave the breeding grounds by the opening of the shooting season, so the hunter kill is low on northern Utah marshes. A map was prepared showing the migration routes and concentration areas in the United States of redheads banded at Bear River.

MOSQUITO CONTROL IN WILDLIFE HABITAT

A detailed experimental project, set up at the Bombay Hook Refuge, Del., in an attempt to demonstrate methods least injurious to wildlife habitat for the control of saltmarsh mosquitoes, common along the Atlantic and Gulf coasts, resulted in an encouraging reduction of mosquito breeding and in an improvement of the area

for waterfowl and other aquatic life. At the Wheeler Migratory Bird Refuge, Ala., where many large impoundments have already been made, cooperative studies with the Tennessee Valley Authority, Bureau of Fisheries, Public Health Service, and Bureau of Entomology and Plant Quarantine have been under way during two summers, with the objective of coordinating more effectively necessary mosquito control with refuge management and wildlife conservation.

LABORATORY RESEARCH ON FOOD HABITS

A summary of laboratory investigations of food habits is contained in table 2, which shows that 6,264 unit analyses were made representing 147 species of amphibians, reptiles, birds, and mammals. In addition, many identifications of plants and plant parts, insects, reptiles, bones, and hairs were made for various institutions and research workers engaged in wildlife investigations.

TABLE 2.—Wildlife food analyses made in 1940, showing by class the numbers of species and units examined

Class	Stomachs		Pellets		Scats		Food remains [1] from—				Total	
							Nests		Dens of mammals			
	Species	Units	Species	Units	Species	Units	Species	Units	Species	Units	Species	Units
Amphibians	1	4									1	4
Reptiles	11	286									11	286
Birds	87	2,632	9	701			2	40			98	3,373
Mammals	30	1,429	1	30	5	1,110			1	32	37	2,601
Total	129	4,351	10	731	5	1,110	2	40	1	32	147	6,264

[1] Numbers represent units of material.

Field observations were made in areas in Arizona where band-tailed pigeons were abundant, analysis of 382 stomachs was completed and the results were tabulated, and a manuscript on a preliminary study of the habits, food, and economic status of these birds was completed.

COOPERATIVE FOOD HABITS RESEARCH

Investigations of Wildlife Research Units

Cooperative research on the food habits of birds, mammals, and reptiles was conducted with 8 of the 10 cooperative wildlife research units, and 1,632 unit examinations representing 19 species were made. The Alabama and Virginia units detailed student assistants to make analyses in the food habits laboratory at Washington, D. C., where large reference collections and laboratory facilities are available.

Aid to Federal, State, and Other Agencies

For the Forest Service, 333 unit examinations of 13 species of animals was made and a paper published on the early winter food habits of the black bear in the George Washington National Forest; for the Soil Conservation Service, 116 bird stomachs of 22 species were analyzed; and for the Public Health Service, National Park Service, Bureau of Animal Industry, and the Tennessee Valley Authority, various stomach and pellet examinations were made.

A collaborator assigned by the Conservation Department of New York examined stomachs of 296 ruffed grouse and 82 ring-necked pheasants collected in that State. Analyses made by the Bureau for other State agencies were as follows: Texas Game, Fish, and Oyster Commission, stomachs of 36 house cats, 11 white-tailed deer, and 10 turtles and 19 otter scats; Michigan Commission of Conservation, 111 stomachs of 5 species of predatory animals and 81 otter scats; Alaska Game Commission, 34 coyote stomachs; California Department of Natural Resources, 54 stomachs of 5 species of predatory animals; Colorado State Game and Fish Commission, 4 house cat stomachs; Montana State Fish and Game Commission, 13 great blue heron stomachs; Nebraska Game, Forestation, and Parks Commission, 4 ring-necked pheasant stomachs; New Mexico State Game and Fish Commission, 29 merganser stomachs; Vermont Department of Conservation and Development, 51 bobcat stomachs. Stomachs of 25 mule deer and of 44 predators of 4 species were analyzed for various States in connection with the Federal aid in wildlife restoration projects, and 56 California quail stomachs were examined for the California Quail Committee. Special examinations made for private individuals and agencies included 391 unit examinations of 36 species and subspecies of birds and 92 unit examinations of 1 species of mammal.

NEW FOOD HABITS LABORATORY AT PATUXENT RESEARCH REFUGE

The Food Habits Laboratory maintained at Washington, D. C., since 1885 was transferred in June to the Patuxent Research Refuge, Bowie, Md., where there was recently completed a 3-story brick building with two floors devoted to laboratories, administrative offices, and library, and the third to scientific collections, equipment, and supplies, where also a modern greenhouse is available for use in studies of wildlife food propagation, and where there is opportunity to work with aquatic plants on the recently created impoundment known as Cash Lake. The new laboratory is named in honor of C. Hart Merriam, the first Chief of the Biological Survey.

The first research contribution from this refuge was issued under the title "Flora of the Patuxent Research Refuge, Maryland" (Wildlife

Leaflet 154, processed). It contains a detailed list of the plants and information about the size, topography, water supply, geology, and soils of the refuge.

STUDIES OF NUTRITION AND PHYSIOLOGY OF UPLAND GAME BIRDS

Cooperation was continued with the Bureau of Animal Industry, United States Department of Agriculture, in bobwhite studies to determine the nutritional requirements of the bird, the nutritive qualities of its native foods, and the effect of various levels of protein intake on its live weight, food consumption, and reproduction. Food selectivity tests were made and mortality problems studied in experiments with 816 young quails to determine the proportion of protein that gives optimum growth and lowest mortality. The nutritive value and palatability of acorns and wild beans and the seeds of lespedeza, black locust, ragweed, crabgrass, and bullgrass were studied in an experiment with 264 adult birds during the winter. A liberation study to determine the survival of captive-reared quails under natural conditions was begun in the fall. A Wildlife Leaflet (BS–163), Common Salt as a Curative for Cannibalism Among Game Birds in Captivity, was distributed and a manuscript on bobwhite quail propagation was completed for publication. The Virginia Polytechnic Institute at Blacksburg cooperated by assigning a collaborator to work out the chemical composition of certain native quail foods. Studies were also initiated to determine the vitamin A content of acorns.

Studies of the physiological activities and metabolic reactions of upland game birds, conducted in cooperation with Cornell University and the New York Department of Conservation, were devoted largely to the designing and constructing of equipment, the most important being a special calorimeter cabinet in which temperature, light, humidity, and air movement are automatically recorded and controlled.

STUDIES OF INJURIOUS BIRDS

Robin and Oriole Damage to Grapes

Investigation of complaints of depredations by robins and Baltimore and orchard orioles on grapes in vineyards near Omaha, Nebr., disclosed that the number of farmers suffering losses was small, but that on some vineyards damage was done to as much as 20 percent of the crop. Experiments involving trapping and shooting and investigations of the use of various frightening devices indicated that the latter may afford relief.

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Crow Depredations on Nesting Game Birds

An analysis of 143 returns from 714 crows banded and released in Oklahoma during the winter of 1935–36 indicated that a large part of the crows wintering in Oklahoma breed in Canada and the Northern States, and therefore local crow control cannot have any appreciable effect on crow depredations on nesting Oklahoma game birds as alleged by promoters of widespread winter crow control in the State.

Sandhill Crane Damage to Grain

Sandhill cranes are wintering apparently in increasing numbers in eastern and southeastern New Mexico, where sorghums, Indian corn, and other small grains comprise much of the cultivated crops. Field investigation has shown that while complaints of damage have some justification, there is a marked variation from year to year in the number of birds present and in the resultant damage. Since the birds are daylight feeders and are easily frightened by gunfire, driving them away locally under proper safeguards and restrictions seems a practical way of preventing this damage.

Duck Injury to Peas and Grain

Ducks wintering in the San Luis Valley, Colo., have at times been the subject of no little complaint because of their feeding on peas left in the fields. To learn their status in winter in this valley, about 330 ducks of 4 species were banded. An appraisal also was made of damage by ducks to grain in northeastern Colorado. Field tests carried on to determine the effectiveness of certain frightening measures against waterfowl were followed by the issuance of a leaflet (BS-149) entitled "Protecting Field Crops From Waterfowl Damage by Means of Reflectors and Revolving Beacons."

Merganser Menace to Game Fish

In response to claims that mergansers were taking great quantities of game fish in the Rio Grande and Pecos Valleys of New Mexico, an investigation was made of the food habits of the birds. Stomach analyses revealed that on the upper Rio Grande the mergansers were not overly destructive to game fish but that they made bass and crappies more than 50 percent of their food on Elephant Butte Lake.

Other Bird-Control Activities

A restatement of Federal policies in bird control in the light of recent problems was presented before the Fifth North American Wildlife Conference in a paper on suggesting methods of approach. The method

suggested rests on the premise that much can be done to alleviate bird damage by the adjustment of cultural and harvesting practices in agriculture and that the farmer can best be approached through the State agricultural experiment station and the extension service.

Experiments in preventing crop damage or controlling birds injurious to crops in California continued and methods as yet incomplete were tested and species that had not before been successfully handled were studied. The third unit of a three-part manual on procedure and methods in controlling birds injurious to crops in California was completed and distributed to qualified county agricultural departments to enable them to handle bird complaints judiciously and conservatively. Leaflets issued on bird control included Protecting Blueberries from Damage by Herring Gulls (BS–141) and Suggestions for the Control of Vagrant Domestic Pigeons (BS–143).

RESEARCH IN THE CONTROL OF HARMFUL MAMMALS

To apply effectively measures for the control of injurious species of mammals it is necessary not only to perfect new traps and better lethal agents but to know the habits of the wild animals with which the farmer and stockman frequently have to contend. The Wildlife Research Laboratory at Denver continued its studies of the life habits of the pine mouse, meadow mouse, mole, porcupine, and woodchuck as a basis for developing improved control methods, as well as those on the use of fumigants and repellents in control practices and methods of application.

Predator Studies

Further experimental work to improve traps and trapping technique and to determine the efficacy of other devices and methods for taking predatory animals was conducted. Studies were continued to determine the relationship of the seasonal drift and other natural habits of coyotes to their predatory tendencies and methods of control.

Repellent Experiments

The control of certain species of injurious animals in many instances can be accomplished through the use of a repellent instead of lethal baits. Noteworthy advances have been made in developing sprays and paints for the protection of trees against rabbit depredations. Sprays reduced the rabbit damage to a stand of pine seedlings in Louisiana and Texas from 35 to 3 percent and to tree plantings in a South Dakota silvicultural experiment from 24.8 to 7 percent. Studies concerned with the development of an inexpensive spray that will withstand adverse weather conditions are being continued.

Laboratory Investigations

Studies were conducted to develop a method to concentrate the active principle of red squill to standardize powders of varying toxicity for use in rat control. In cooperation with the University of Beirut, at Lebanon, Syria, studies were continued to determine the relationship of the toxicity of squill bulbs to growing and cultural conditions, and in cooperation with the New Mexico A. and M. College experiments were inaugurated in growing squill bulbs in this country.

FUR-ANIMAL CONSERVATION AND RESTORATION

FUR PRODUCTION AND THE FUR TRADE

War and the Fur Trade

War conditions have made imports and exports of furs more difficult and have called former trappers in foreign countries into the military service. As the shortage of fur imports increases and domestic markets depend more and more upon American production, larger numbers of native fur animals will be needed to meet the demand. To maintain our own source of supply will necessitate limited trapping, shorter seasons, and Federal, State, and individual cooperation in the production and conservation of fur animals. A deeper realization of the purpose and possibilities of producing more fur animals on State and Federal lands and on fur farms is being developed.

Fur Supply and Annual Take

The trapping required to supply the Nation's $50,000,000 fur market indicates that the consumption of furs in the United States is exceeding the annual production. The danger of depleting this great natural resource was stressed by the Secretary in a statement based on available figures on the national annual take of fur animals, which emphasized that the data are not accurate enough to maintain a careful check on the situation. Lack of authentic information on the numbers and origin of animals trapped annually in the United States and on the number of domestic furs marketed prevents an intelligent estimate of the annual harvest. The States cannot undertake effective management of their fur resources until they require reports on the extent of the season's trapping, as a basis for assembling accurate data relative to the populations of the animals.

Silver Fox Quota

The outbreak of the European war would have forced out of business nearly all the silver fox farmers in the United States had not prompt action been taken to prevent the dumping of Canadian and European

pelts on the American market. Recognizing the situation as the most critical in the 30-year history of American fur farming, the Secretary called to the attention of the Committee for Reciprocity Information the possibility that a flood of foreign furs would undermine the American industry. Conferences between representatives of fur farmers and various Government officials followed, and a Supplementary Trade Agreement between the United States and Canada was negotiated on December 30, 1939, establishing an import quota of 100,000 silver foxes, including both live animals and pelts. Establishment of this limit not only maintained but increased the prices paid for silver fox pelts during the winter. The sale of a single Norwegian platinum fox pelt for $11,000 and of an entire lot of 400 platinum skins for more than $500 each gave impetus to the production of platinum and freakishly colored foxes in the United States. The Bureau of Customs decided that the platinum type of fox falls within the range of silver foxes as recognized in the United States and is therefore dutiable and comes within the import quota.

Selling Federal Furs

The national wildlife refuges are great reservoirs for fur-animal life, and the restoration and development of this natural resource, based on research, are elements essential to their management. A definite policy was established for handling and disposing of all furs that become surplus property of the refuges, and a system of selling is being devised that will supply valuable information in the fur-research field, return a maximum revenue to the Government, and reduce administrative details.

COOPERATIVE INVESTIGATIONS

Reproduction Studies

Minks.—In studies on the reproductive cycle of fur animals conducted in cooperation with the Bureau of Animal Industry of the United States Department of Agriculture, Swarthmore College, and the Carnegie Institution of Washington, a colony of 27 minks was maintained at Swarthmore College for intensive study. A number of articles published officially, and otherwise, reported the results of these researches.

Foxes.—Studies of female silver foxes were correlated with whelping and breeding records. During the breeding season 10 females and 5 males were used for intensive studies on reproduction. Electric-current requirements for killing foxes to be pelted were studied in cooperation with Swarthmore College.

Muskrats.—Reproductive tracts of 72 male and 55 female muskrats taken during the trapping season were examined and 1,050 histological sections prepared.

Nutritional Studies

Nutritional research on fur animals was conducted cooperatively with the Bureau of Animal Industry of the United States Department of Agriculture and Cornell University. In metabolism experiments with silver foxes and minks, continued from last year with different feeds, minks were found to digest cooked starch and grains more readily than raw, and this trait is being studied also for silver foxes. Foxes digest about 10 percent more of a given feed than minks, probably because of their longer digestive tracts. To establish a normal standard for the comparison of pathological cases, analyses were made of the blood of both foxes and minks.

The principal nutritional problem studied was on the vitamin requirements of fur animals. Preliminary work with adult animals indicated that sufficient body reserve of vitamins A and D may be stored for summer use by spring feeding of diets rich in these vitamins. Results obtained from feeding to adult minks rations containing no vitamin C indicated that this vitamin is not essential for maintenance of their health, but further work is necessary to determine whether fur quality, breeding ability, or special functions are affected by its absence. Other experiments indicate that calcium and phosphorus are essential during the reproduction and lactation periods of foxes and minks and that fur breeders should supply feeds containing sufficient vitamin D.

Fur-fiber Investigations

In cooperation with the Bureau of Animal Industry of the United States Department of Agriculture, much time was devoted to a study of fur fibers. Silver fox and mink furs have three main types of fiber—the underfur and the regular and single guard hairs, and all three types differ from each other in relative length, form, surface structure, and distribution with respect to the follicles.

Through the cooperation of scientists of the Bureau of Standards, an instrument has been constructed for measuring gloss, in order to correlate it with what the eye recognizes as luster.

Technical analysis of the structure of fibers of Karakul and other sheep led to the discovery of smaller units of structure than previously recognized, namely, spherical keratin particles less than 1 micron (one twenty-five thousandth inch) in diameter that may bear pigment and are arranged systematically. The clarification of such minute details of structure is fundamental to the understanding of the gross characteristics of the fibers, which in turn determine the quality of furs.

Karakul Sheep Studies

The Karakul sheep study was continued in cooperation with the Bureau of Animal Industry at the Agricultural Research Center at Beltsville, Md., where the experimental herd produced 59 lambskins. These were cut into halves, half of which were dressed and dyed and the other half left in the raw state to determine the effect that processing has on shape and size of curl, luster, and other qualities. These lambskins were also graded and valued according to standard samples, first by the cooperators and then by fur-trade specialists.

FUR ANIMAL EXPERIMENT STATION, NEW YORK

One of the major problems studied at the Fur Animal Experiment Station, Saratoga Springs, N. Y., was to find cheaper substitutes for meat in the rations of fur animals. This quest becomes more important each year in the case of silver foxes as the prices for pelts are still declining. Beef meal fed in summer was satisfactory and the animals developed good fur. The work demonstrated also that soybean meal can replace the usual weight of beef meal with good results, and the possibility was studied of feeding tripe, udders, lungs, and other packing-house offal. The summer feeding of foxes exclusively on a dry ration in the form of cubes or pellets was tested toward the end of the year. In mink-feeding experiments, canned fish, fishmeal, and tripe were used as substitutes for raw meat and satisfactory results obtained at a much lower cost.

Construction work at the station begun by the W. P. A. was completed, and a new project was begun near the end of the year to provide a residence, additional laboratory facilities, refrigeration unit, heating plant, and new fur-animal pens.

RABBIT EXPERIMENT STATION, CALIF.

That a protein supplement to the grain-hay ration is a necessity for producing rabbits economically was demonstrated by tests with 240 does and 1,636 young rabbits fed for 30 months on peanut, soybean, hempseed, and linseed meals, at the Rabbit Experiment Station, Fontana, Calif. Rations having a narrow nutritive ratio (proportion of digestible protein to total digestible carbohydrates and fats) were found most satisfactory. The pea-sized cake, or pelleted form, of these meals were best adapted for preparing mixtures with grains and for self-feeding.

For 25 months, 48 does and 1,813 young were fed to determine the value of a ration in which cereal grains were limited, and the results proved that feed mixtures for does and litters may consist of one or

more cereal grains properly balanced with the plant protein supplements. Choice of oats, wheat, barley, and sorghum in the feed mixture depends upon the quality and relative cost.

In a 5-year experiment in self-feeding does and litters, now completed, rabbits demonstrated their ability to balance their own rations when given free choice of adequate feeds. Self-fed fryer rabbits, weaned at 56 days of age, averaged 6.8 percent heavier and required 15 percent less feed to produce a unit of gain in live weight than rabbits hand fed a comparable ration.

FUR ANIMAL FIELD STATION, MARYLAND

On the Blackwater Refuge, Maryland, the fur animal field station is developing knowledge on populations, carrying capacity, permissible annual take, breeding season, prime-fur period, and other factors in fur-animal management. A count of the muskrat houses on the 5,248 acres of marsh revealed 26,631 inhabited and 3,947 feed houses. The number of lodges ranged from 3.5 to 9.31 per acre and averaged 5.8. The ratio of feed houses to inhabited lodges was 1 to 6.6.

Extremely cold weather in March delayed the muskrats' breeding period and the growth of plants on the marsh. The first evidence of breeding was noted during the latter part of April, when the green shoots of the three-square also were observed. Litters were born on the marsh at the beginning of April and in pens during the latter part of that month. Two cases of mutation in the brown Maryland muskrat were found, the variety being devoid of guard hairs and having the short underfur wavy and of fine texture and good sheen. Contestants from various States were entered in a muskrat-skinning contest, promoted by the director of the station and held in a theater at Cambridge, Md. The winner removed five pelts in 2 minutes and 38 seconds.

Muskrats and other fur animals are maintained in pens of various sizes and kinds for research purposes. Reproduction in the pens this year was satisfactory, a total of 20 litters being produced. The study to determine the palatability of various feeds for muskrats is being continued. Two female and one male nutria were purchased. A litter was produced and there are now 9 mature animals and 4 young at the station.

WILDLIFE-DISEASE RESEARCH

FUR-ANIMAL DISEASE CONTROL

Research on definite strains of distemper in silver foxes and minks revealed specific qualities of the viruses, tests on the viability of which show a ready susceptibility to injury by light and ordinary

drying; rapid freezing at low temperatures in vacuo, however, permits storage of specific strains with retention of virulence. Advantage was taken of this proved susceptibility of the virus to natural destruction in the eradication of disease from ranches by temporarily protecting all the stock with homologous serum until no live virus remained.

Control of outbreaks of paratyphoid in silver fox herds has been simplified by use of commercial livestock paratyphoid vaccine. Previously it had been considered safe to use only an autogenous product developed from the particular strain existing in the herd to be treated.

Study of a new disease in minks, known as "cotton" mink, showed that the under fur assumes a pale shade, almost white, making the pelt practically worthless. A relationship between the defective pelage and the abnormal functioning of the digestive process was noted in affected animals.

GAME-BIRD DISEASES

Through extensive use of the Winkler method of oxygen determination and toxicity tests with experimental animals, a close relationship between oxygen depletion and outbreaks of botulism in waterfowl was demonstrated. Tests showed that this reduction in oxygen is brought about by the growth of aerobic organisms during the early stages of decay of plant and animal matter on the shore lines of lakes. Experiments are being conducted with various devices for instilling oxygen into the water to inhibit the multiplication of the botulinus organisms.

PHYSICAL PROPERTIES OF QUAIL FEEDS STUDIED

Extensive losses among young pen-raised quails were shown to be due to excessive quantities of fiber causing impaction in the digestive canal. This finding makes it evident that nutritive values alone are not to be relied upon in developing a ration for young quails but that the physical properties of feeds also must be given careful consideration.

INFECTIOUS DISEASES IN BIG GAME

Assistance was given the Forest Service of the United States Department of Agriculture in diagnosing an outbreak of hemorrhagic septicemia in deer and making recommendations for its control. In numerous autopsies, the bipolar germ characteristic of the disease was demonstrated in the blood.

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In cooperation with the Bureau of Animal Industry of the United States Department of Agriculture and the veterinary staff at Fort Sill, Okla., diagnosis was made of Bang's disease in the buffaloes and long-horned cattle on the Wichita Refuge on the basis of the blood tests. Control by vaccinating the young stock was recommended.

RESEARCH ON NATIONAL PARK WILDLIFE

WILDLIFE RELATIONSHIPS

On January 1, 1940, the wildlife research work formerly done by the National Park Service was transferred to the Bureau of Biological Survey, by direction of the Secretary. Since that date, continuing work begun several years ago, major emphasis has been placed upon investigations of prey-predator ecology. Field work was centered on wolf-sheep problems in Mount McKinley National Park, Alaska, to which a biologist who spent 7 months there in 1939 returned for a second season. His laboratory studies of field material, carried on during the winter, have not progressed far enough to warrant publication of conclusions, but they indicate that climatic and range conditions are greater factors than predation by wolves in the fluctuations of the Dall sheep populations.

A closer coordination among all research agencies working on bighorn sheep in the Rocky Mountains was effected through agreements between the National Park Service, the Grazing Service, and the Bureau of Biological Survey, of this Department, the Forest Service, of the Department of Agriculture, and the States concerned. A consequent improvement in assembling and distributing data has resulted in more effective efforts to conserve this endangered species. Contribution from national park areas to this cooperation has come from Rocky Mountain National Park, Colo., where the dietary and mineral requirements of bighorns are being investigated; from Yellowstone National Park, Wyo., where migration and range are being studied by the naturalist staff; and from the Glacier National Park, Mont., where the regional biologist and the park staff are making observations upon lambing-range requirements and improvement. Inventories in Death Valley National Monument, Calif., show a gradual improvement in the status of the Nelson bighorn but indicate a need for eliminating stray cattle and burros. Similar range competition is found to be imminent on the Boulder Dam National Recreational Area, Nev. Studies in the Organ Pipe Cactus National Monument, Ariz., show that distribution of water holes may be the present limiting factor in the conservation of the Gaillard bighorn.

Other inventories included a survey of the botanical resources of Mount McKinley National Park, through cooperation of the Univer-

sities of Wyoming and Alaska; preliminary surveys in California of wildlife on the new Channel Islands and Joshua Tree National Monuments, and in Utah, at Capitol Reef National Monument.

Other research projects included a study of mosquito-control methods on national park areas in the Southeastern States, resulting in recommendation of pyrethrum in preference to fuel oil as a larvicide; studies of reported overpopulations of deer on the Hickory Run Recreational Demonstration Area, Pa., and of deer, wild turkeys, and raccoons on the Colonial National Historical Park, Va.; appraisal of wildlife habitats along the Blue Ridge Parkway; investigation of mixed-type habitats versus solid forests in southeastern areas; continuance of surveys of the trumpeter swan in Yellowstone National Park; and observations of forage utilization by elk, deer, bighorns, and beavers in Rocky Mountain National Park.

RANGE-IMPROVEMENT STUDIES

Investigations of methods for improving forage conditions were continued in Rocky Mountain National Park, where the effect of heavy elk browsing, especially on aspen, is being studied in relation to use of the same food by deer and beavers. Resultant recommendations for a reduction in the size of the elk herd are now being carried out by the National Park Service. Long-term range studies were also continued by the use of exclusion plots on the floor of Yosemite Valley, Calif., where deer are numerous; and in Zion National Park, Utah, where a recommendation for the removal of about 50 surplus deer has been made. Overbrowsing by deer was investigated also in several small eastern areas, including Hickory Run and French Creek Recreational Demonstration Areas, Pa., and Colonial Historical Park, Va. In the Pennsylvania areas overbrowsing will be corrected or prevented under a recent agreement, approved by the Secretary, whereby the National Park Service and the State Game Commission will cooperate in regulated hunting on such demonstration areas as require management measures to preserve recreational values; in Virginia overabundance of deer in the Colonial Park is being handled in cooperation with the State by live trapping surplus animals and transplanting them to understocked sections.

Dual use of range by wildlife and domestic stock was investigated in several national park areas where to avoid hardship to cattlemen land-acquisition agreements provide for a continuance of grazing for a limited period. As a result of these studies the following management practices have been adopted by the National Park Service:

Through an agreement with the Grazing Service, approved by the Secretary on February 20, 1940, grazing privileges are being expedi-

tiously handled by fieldmen of both services on the basis of gradual reduction and eventual elimination on Carlsbad Caverns National Park addition, N. Mex.; Grand Canyon National Monument, Ariz.; Zion National Monument, Utah; and Dinosaur Monument addition, Utah and Colorado. Areas adjacent to forest reserves, including Bryce Canyon National Park, Utah, and Kings Canyon National Park, Calif., are receiving similar tapering-off management. Other plans affecting grazing contemplate the eventual removal of saddle horses from a bighorn lambing ground in Glacier National Park; elimination of stray cattle and feral burros from important bighorn ranges in the Death Valley National Monument; and improvement of water holes for antelopes in the White Sands National Monument, N. Mex.

BIOLOGICAL SURVEYS AND WILDLIFE INVENTORIES

In Sequoia National Park, Calif., a comprehensive faunal survey has been completed and a report on the field work partly prepared for publication. Field and laboratory work on a similar survey of the new Kings Canyon National Park was begun in the spring. Improvements in making and recording annual wildlife inventories in the national parks have rendered the data more usable in management and publicity projects. The results of the improved inventory were published in Conservation Bulletin 3, Wildlife Conditions in the National Parks: 1939.

FEDERAL AID IN WILDLIFE RESTORATION

The satisfactory progress under the Federal Aid to Wildlife Restoration Act (50 Stat. 917), commonly known as the Pittman-Robertson Act, was continued and expanded during its second year of operation. Having become better acquainted with its provisions, the States have been able to engage in well-studied restoration programs designed for the most part to benefit all sections, and their activities have already accomplished much for wildlife. Information on the program and the text of the law and regulations were published in Wildlife Circular 3.

All 43 of the eligible States (5 have not enacted the necessary legislation to provide for their participation—Florida, Georgia, Louisiana, Montana, and Nevada) are now engaged in wildlife-restoration projects, the nature of which varies greatly. Some of the Eastern and Southern States have acquired large tracts to provide additional sanctuaries for deer, wild turkeys, ruffed grouse, and fur animals. Western States have emphasized the purchase of winter range for deer, elk, and other big-game species, and the provision

of additional water facilities for prairie chickens and sage grouse. Many States have inaugurated State-wide wildlife-resource surveys to inventory wildlife populations and ascertain limiting factors with the view of inaugurating better management procedures.

The conduct of these projects has afforded employment to a number of graduates of colleges that offer wildlife-management courses. The States find it advantageous to use trained personnel in their wildlife work, and the training courses available are recruiting others to careers in wildlife management. In their wildlife-restoration activities the States report splendid cooperation by other governmental agencies, including the Forest Service, Agricultural Adjustment Administration, Civilian Conservation Corps, Soil Conservation Service, Grazing Service, Bureau of Indian Affairs, and National Park Service.

Of the funds appropriated in 1939, the $546,068 not expended was available for obligation, together with the current appropriation of $1,500,000, of which $1,400,000 was directly apportioned to the States. The Federal funds available for the States during 1940 thus amounting to $1,946,068 were increased by the required 25-percent State contributions to $2,594,757. The money is apportioned for wildlife-restoration projects on the basis of the land area and the number of hunting-license holders in each State. All costs of undertakings are borne by the State game departments, after which reimbursement is made from Federal funds for the Government's pro rata share, which may not exceed 75 percent of the total.

Approval of projects is limited to those of substantial character and design and of benefit to wildlife. The year's restoration program involved the obligation by the States of $2,082,735 on 237 individual restoration projects—51 for the acquisition of land and water for wildlife, at an estimated cost of $487,512; 101 for the development of land and water to improve wildlife conditions, at a cost of $713,953; and 85 for the investigation of wildlife conditions and their relationship to existing agricultural and land-use practices, at an expenditure of $881,270. The features of the restoration activities grouped for each State are shown in table 3.

The States cooperating plan to continue their programs for 1941 under the increased funds made available (Congress appropriated $2,500,000). It is anticipated that the restoration program will be extended and expanded in proportion to this increase and to the increased ability of the game departments through experience gained in operations during the past 2 years.

TABLE 3.—Nature of the 1940 Federal-Aid-In-Wildlife Restoration Projects and the Estimated Cost

State; and total funds available	Purpose of project	Estimated cost
Alabama	To inventory the principal wildlife species	$27,120
$46,015.	To establish muskrats and beavers in coastal marshes and streams	2,134
Arizona	To survey the wildlife resources	44,869
$63,851.	To restore quails in suitable habitats	4,356
	To establish beavers on forest lands	946
	To introduce pheasants in irrigated valleys of the Gila, Salt, and Verde River watersheds.	1,837
	To restore wild turkeys in national forests	2,174
Arkansas	To construct headquarters facilities on State game lands in Howard County.	15,150
$35,019.	To establish wild turkeys on State game refuges	5,500
California	To study the management of the valley quail in the southern counties	7,252
$127,858.	To develop existing water supplies for quails and create new ones in desert areas.	15,000
	To restore springs, water holes, and habitat for sage grouse	10,000
	To study limiting factors on mule deer in southern counties	12,000
	To inventory the fur resources	9,704
	To conduct a comprehensive study of beavers and their management	1,600
Colorado	To survey the wildlife resources	29,611
$76,980.	To purchase deer winter-feeding area in Rio Blanco County	2,150
	To acquire winter-feeding area for deer and elk in Gunnison County	20,190
	To fence the Wray Upland Bird Refuge for prairie chickens, quails, and pheasants and improve the habitat.	1,615
	To purchase Hot Sulphur deer-elk winter-feeding grounds	3,325
	To provide water facilities on Great Divide sanctuaries	3,482
	To purchase big-game winter-feeding area on Frying Pan River, Eagle County.	8,150
Connecticut	To study ruffed grouse management	4,200
$8,574.	To fence the Scoville Wildlife Sanctuary for pheasants, grouse, and rabbits and improve the habitat.	922
Delaware	To determine the value of seed-stock areas in maintaining wildlife	4,659
$4,685.		
Florida		(1)
$41,990.		
Georgia		(1)
$44,651.		
Idaho	To determine populations and distributions of the more important wildlife species.	41,936
$61,206.	To purchase the Hagerman Valley Waterfowl Refuge	18,045
	To improve waterfowl conditions on the Hagerman Valley Refuge	5,302
	To purchase the Idaho County Bird Refuge	1,130
	To fence and post the Idaho County Refuge and improve the wildlife habitat.	684
	To purchase the Nez Perce Bird Refuge	1,130
	To fence and post the Nez Perce Refuge	1,665
	To develop 8 waterfowl areas for sage grouse in Lincoln and Minidoka Counties.	3,296
	To develop springs and water seeps for sage grouse	1,048
	To reclaim 4 springs in Owyhee County for wildlife	1,933
	To improve 3 springs for sage grouse and antelopes	1,200
	To establish beavers in mountain streams in forest regions	14,775
	To establish Hungarian partridges on depleted areas	1,375
	To introduce pheasants on suitable depleted areas	2,525
	To post 40 State refuges	3,500
Illinois	To study upland-game management	3,860
$89,678.	To develop seed-stock refuges on farms	13,603
	To investigate squirrels and raccoons	3,725
	To study food supplies of upland game birds	2,618
	To develop Horseshoe Lake for geese	12,004
	To fence upland-game study areas and improve the wildlife habitat	2,777
	To survey and select prairie areas suitable for conducting wildlife-management studies.	2,600
	To purchase the Green River Waterfowl and Upland Game Refuge	49,837
Indiana	To fence the Hovey Lake Refuge and construct headquarters buildings	14,365
$113,933.	and stabilize water levels.	
	To conduct State-wide wildlife survey and game-management demonstration.	38,250
Iowa	To purchase the Rice Lake waterfowl and upland game area	30,362
$57,838.		
Kansas	To fence and post the Kingman County State Game Preserve and improve	7,881
$58,012.	the habitat for pheasants, quails, and waterfowl.	
	To stabilize water levels on the Republic County State Game Preserve	2,500
	To fence the Finney County State Game Preserve for buffaloes and for lesser prairie chickens and other game birds.	6,791
	To restore and manage pheasants	15,000

[1] Ineligible to participate.

TABLE 3.—Nature of the 1940 Federal-Aid-In-Wildlife Restoration Projects and the Estimated Cost—Continued

State; and total funds available	Purpose of project	Estimated cost
Kentucky $41,703.	To purchase the Flatwoods Deer and Turkey Refuge	$6,070
	To develop the Flatwoods Refuge	2,202
	To develop Harlan wildlife area for deer and turkeys	2,572
Louisiana $40,844.		[1]
Maine $37,844.	To determine means of developing the State's 2,500 lakes for waterfowl, fur animals, and other wildlife.	8,535
	To establish aquatic food and cover plants in some of the lakes	19,275
Maryland $20,313.	To acquire the Indian Springs Game Refuge for quails, turkeys, rabbits, and squirrels.	11,114
	To fence and post the Indian Springs Refuge and improve the wildlife habitat.	3,400
	To fence and post wildlife-refuge parts of State forests and improve the wildlife habitat.	3,250
Massachusetts $20,016.	To conduct a comprehensive study of pheasant management on test and check areas.	8,000
	To investigate winter range and food conditions for black ducks and Canada geese.	6,000
	To develop areas on the Federation of Women's Club State Forest for rabbits, deer, and ruffed grouse.	600
	To improve wildlife conditions in the Windsor State Forest	350
	To improve wildlife conditions in the Hawley State Forest	1,250
	To improve wildlife areas for deer in the Myles Standish State Forest	1,200
Michigan $173,878.	To ascertain habitat requirements of ring-necked pheasants	6,920
	To study habitat requirements of fox squirrels	5,330
	To study survival and behavior of Hungarian partridges	7,158
	To study ecological successions after forest fires	8,500
	To study coordination of wildlife with agricultural practices by practical experiments.	10,345
	To ascertain range competition between sharp-tailed grouse and prairie chickens.	5,500
	To study practical raccoon management	4,000
	To purchase an upland-game area in Barry County	31,345
	To purchase upland-game lands in Tuscola County	16,605
	To purchase lands for the Rose Lake Wildlife Experiment Station	10,125
Minnesota $90,406.	To fence and post the Red Lake Refuge	4,173
	To post 114 State game refuges	24,803
	To reestablish quails and pheasants on State refuges	17,754
Mississippi $47,257.	To improve wildlife conditions for deer, turkeys, and beavers in national forests.	4,712
	To fence the H. B. Cole Refuge, improve the wildlife habitat, and reestablish deer and turkeys.	13,793
	To fence the Leroy Percy Refuge and improve the wildlife habitat	9,111
	To determine populations and distribution of the wildlife resources	11,979
Missouri $69,467.	To conduct a survey of the wildlife resources	55,500
	To purchase lands for deer and turkeys in the Ozark Mountains	9,437
	To fence and post the Caney Mountain Refuge in the Ozarks and improve conditions for deer and turkeys.	9,938
Montana $91,505.		[1]
Nebraska $70,084.	To increase and establish ring-necked pheasants	19,868
	To restore and improve conditions for quails	26,087
Nevada $57,714.		[1]
New Hampshire $15,902.	To study ruffed grouse populations, needs, limiting factors, and management.	12,869
	To improve food and cover on experimental grouse-management areas	4,246
	To ascertain populations, species, and conditions of ducks	835
	To study and improve conditions for pheasants, grouse, ducks, and fur animals.	3,000
New Jersey $32,316.	To lease seed-stock refuges in Somerset County for pheasant and rabbit management.	1,037
	To acquire areas for deflecting deer from agricultural lands	941
	To study the condition of cottontail rabbits and recommend future management.	2,279
	To ascertain the value of seed-stock refuges for pheasants	5,508
	To improve food and cover on Somerset County seed-stock refuges	4,428
New Mexico $67,275.	To acquire 2 prairie chicken and quail refuges in Roosevelt County	6,481
	To fence the 2 Roosevelt County refuges and improve the water facilities	4,072
	To reestablish the antelope	8,272
	To improve water supplies for bighorn sheep	2,420
	To purchase 2 refuges in Taos County for sage grouse	8,534
	To purchase a refuge for wild turkeys, waterfowl, fur animals, and deer in Sandoval County.	5,506

[1] Ineligible to participate.

TABLE 3.—Nature of the 1940 Federal-Aid-In-Wildlife Restoration Projects and the Estimated Cost—Continued

State; and total funds available	Purpose of project	Estimated cost
New York, $169,676.	To post seed-stock refuges for farm game and improve the food and cover	$10,829
	To lease seed-stock refuges for farm game	14,446
	To plant trees and shrubs on State lands for food and cover for deer, ruffed grouse, and cottontail rabbits.	7,436
	To construct a pathological laboratory at the Delmar Research Center	27,206
	To study effective management practices for important species of game	53,956
North Carolina, $59,755.	To develop the 70,000-acre Holly Shelter Wildlife Refuge	56,920
	To acquire lands for access to the Holly Shelter Refuge and for a headquarters site.	7,357
	To survey farm-game management practices under field conditions	13,581
	To survey conditions for and to evaluate the fur resources	8,483
	To improve food and cover on the 40,000-acre Sandhills Wildlife Refuge	1,826
	To construct small water impoundments on the Sandhills Refuge	9,583
	To improve food and cover for deer and turkeys on the John Pickett Council Refuge.	724
North Dakota, $39,423.	To fence the Dawson Refuge and improve cover and provide water	4,631
	To provide food and cover for waterfowl, Hungarian partridges, sharp-tailed grouse, and pheasants on the Cedar Lake Refuge.	1,500
	To fence and post the Morton County Refuge and improve water conditions.	1,769
	To purchase the Dawson Refuge	3,340
	To survey the wildlife resources	12,300
Ohio, $133,857.	To survey the wildlife resources and correlate game management and existing agricultural practices.	38,500
	To conduct grouse management and improve environment on Jackson County lands.	2,188
	To study comprehensively grouse-management practices on selected areas	13,953
	To conduct grouse management on 1,400 acres in Washington County	2,625
Oklahoma, $54,386.	To restore and manage the bobwhite quail	42,630
	To survey the wildlife resources	46,435
Oregon, $66,042.	To establish seed-stock refuges for small game in the Willamette Valley	7,862
	To reseed parts of the Tillamook burn	3,000
	To establish and manage beavers	10,301
	To develop water supplies and habitat for sage grouse	8,060
Pennsylvania, $157,902.	To study forest-wildlife relations	11,385
	To study ecological conditions best suited for pheasants, Hungarian partridges, rabbits, and quails.	5,885
	To study native fur animals	7,625
	To study the relationship of nutrition to reproduction among white-tailed deer.	7,350
	To conduct an economic survey of muskrats, skunks, and foxes	5,850
	To recondition headquarters buildings at the Loyalsock Experiment Station.	2,850
	To purchase 20 additional tracts for State game lands	71,155
Rhode Island, $2,501.	To investigate practicable game management	2,245
South Carolina, $34,890.	To reestablish quails on improved areas in the Sumter National Forest	2,060
	To reestablish quails on improved areas in the Poinsett State Forest	19,259
South Dakota, $46,118.	To purchase lands for the Gherkin Refuge for waterfowl, pheasants, and Hungarian partridges.	6,199
	To purchase the Buffalo Slough Waterfowl Refuge	12,361
Tennessee, $36,659.	To acquire land for an upland-game refuge	17,021
	To fence the Cheatham County Refuge and provide deer-seed stock	5,414
Texas, $158,632.	To investigate desert bighorns	4,969
	To survey the wildlife resources	131,055
	To restore the collared peccary	1,086
	To improve habitat for quails and reestablish the birds in depleted covers	24,255
	To establish the antelope on suitable depleted ranges	2,530
	To restore white-tailed deer and wild turkeys on suitable depleted ranges	8,202
Utah, $54,433.	To study the relationship of beavers to stream run-off	1,500
	To purchase deer winter-feeding area in Box Elder County	10,185
	To study summer and winter feeding conditions for mule deer	11,410
	To purchase land and water rights for improving the Provo Bay Waterfowl Refuge.	2,115
	To purchase the Cache experimental winter-feeding area for deer	2,000
	To improve waterfowl conditions in Ogden Bay by water impoundment	25,860
	To purchase lands in Millard County for deer winter range	8,591
Vermont, $14,835.	To survey the wildlife resources	4,000
	To study deer management	1,264
	To survey the fur resources along Lake Champlain	926
Virginia, $50,527.	To survey the wildlife resources	27,000
	To study the effect of forest clearings on wildlife	3,400
	To restore wild turkeys on protected areas	5,000
	To restore deer in the George Washington and Thomas Jefferson National Forests.	19,798
	To restore the quail in counties east of the Blue Ridge Mountains	7,220

TABLE 3.—Nature of the 1940 Federal-Aid-In-Wildlife Restoration Projects and the Estimated Cost—Continued

State; and total funds available	Purpose of project	Estimated cost
Washington	To purchase lands for the Sinlahekin Deer Refuge	$22,286
$80,414.	To protect the Sinlahekin Refuge from grazing by constructing fences and cattle guards.	565
	To purchase an antelope range in Kittitas County	17,565
	To fence and post the Squaw Creek Antelope Range and improve the habitat.	5,239
	To purchase an elk range in Yakima County	3,554
West Virginia	To purchase the Panther Creek deer and turkey refuge in McDowell County.	37,647
$51,161.	To survey the wildlife resources	20,000
	To reestablish deer on State refuges	9,735
	To post, brush out boundaries, afford fire protection, and construct headquarters on the Nathaniel Mountain Wildlife Refuge.	5,116
	To fence and post the Braxton County Game Refuge and construct headquarters buildings.	6,183
	To post 6 State wildlife refuges	1,375
Wisconsin	To study management problems of white-tailed deer	8,800
$81,442.	To study conditions for sharp-tailed and pinnated grouse and the management problems.	8,350
	To ascertain ways of improving waterfowl conditions	4,600
	To survey pheasant populations and conditions	9,400
	To study quail populations and the influence on them of climatic conditions.	200
Wyoming	To survey and restore sage grouse	13,236
$53,863.	To ascertain factors determining the abundance of bighorns	7,350
	To purchase 2 winter-feeding areas for elk	10,176

ACQUISITION OF LAND FOR REFUGES

Following approval by the Migratory Bird Conservation Commission of proposed acquisitions, 159 separate tracts, comprising 59,898 acres, were added to 20 existing national wildlife refuges throughout the country. These approvals involved relatively small units needed within existing boundaries to facilitate administration. Executive orders for the establishment of the Noxubee, Miss., and the Bosque del Apache, N. Mex., Refuges, for the enlargement of 4 existing refuges, and for one revocation involved 667.23 acres of public domain and 105,967.05 acres acquired by purchase. Details of the accomplishments in refuge-land acquisition are given in table 4.

Surveys were made of 294 miles of boundary lines and of 110 miles of interior or contiguous lines required by reason of lost and obliterated corners; 48 miles of level lines were run; 373 miles were marked to define the boundaries of existing refuges; and 115 miles of boundary lines were staked preliminary to fence construction. Survey descriptions necessary for title examinations and preparing deeds of conveyance for 827 tracts were completed for approximately 22,377 acres, of which 242 tracts of 8,356 acres with irregular boundaries were surveyed preliminary to the preparation of definitive land descriptions. Topographic surveys of 180 acres were made and detailed maps compiled therefrom.

TABLE 4.—Tracts, in acres, acquired or in process of acquisition for national wildlife refuges and related uses under the Migratory Bird Conservation Act, with emergency and other funds, and by gift and Executive order or proclamation

State and county	Refuge	Fiscal year 1940								Acquired in previous years
		Under Migratory Bird Conservation Act			With emergency and other funds			Acquired other than by purchase	Total	
		Acquired by purchase	Pending title conveyance	Total	Acquired by purchase	Pending title conveyance	Total			
Arizona: Mohave	Boulder Canyon (see also Nevada)									312,047
Arkansas: Arkansas, Desha, Monroe, and Phillips.	White River	271	5,293	5,564	160	152	[1] 312		5,876	[2] 102,250
Delaware: Kent	Bombay Hook	4	1,630	1,634					1,634	12,006
Florida: Jefferson, Taylor, and Wakulla	St. Marks		1,803	1,803		11,884	[3] [4] 11,884		13,687	[2] 49,640
Georgia: Jasper and Jones	Piedmont					1,326	[4] 1,326		1,326	[2] 28,674
Idaho: Jefferson	Camas		296	296					296	10,239
Illinois:										
Mason	Chautauqua		31	31		271	[1] [5] 271		302	4,100
Carroll, Jo Daviess, Rock Island, and Whiteside.	Upper Mississippi (see also Iowa, Minnesota, and Wisconsin).									5,256
Iowa:										
Kossuth	Union Slough	256	106	362					362	730
Allamakee, Clayton, Clinton, Dubuque, Jackson, and Scott.	Upper Mississippi (see also Illinois, Minnesota, and Wisconsin).									24,441
Kentucky: Lyon and Trigg	Kentucky Woodlands				238	2,677	[4] 2,915		2,915	[2] 46,090
Louisiana:										
Plaquemines	Delta		7,172	7,172	8,711		[3] 8,711		15,883	[2] 34,300
Cameron	Sabine		438	438					438	147,340
Maine: Washington	Moosehorn	439	3,658	4,097					4,097	[2] [4] 17,165
Maryland:										
Anne Arundel and Prince Georges	Patuxent	432		432					432	2,693
Cecil and Harford	Susquehanna (closed area)							[6] 21,210	21,210	
Massachusetts: Barnstable	Monomoy		322	322					322	
Michigan: Schoolcraft	Seney	7,419	10,672	18,091					18,091	[2] 68,067
Minnesota:										
Aitkin	Rice Lake	1,281	307	1,588	157		[3] 157		1,745	9,714
Becker	Tamarac	40	8,974	9,014					9,014	22,914
Houston, Wabasha, and Winona	Upper Mississippi (see also Illinois, Iowa, and Wisconsin).					[7] 2,493	2,493		2,493	14,478
Mississippi: Noxubee, Oktibbeha and Winston.	Noxubee							[4] [6] 38,239	38,239	
Missouri:										
Stoddard and Wayne	Mingo		25,000	25,000					25,000	
Chariton	Swan Lake	566	883	1,449					1,449	9,221

Montana:										
Roosevelt and Sheridan	Medicine Lake				345	1,898	[3] 2,243		2,243	21,275
Beaverhead	Red Rock Lakes				7,209		[3] 7,209		7,209	24,965
Nebraska: Garden	Crescent Lake		720	720					720	42,629
Nevada:										
Clark	Boulder Canyon (see also Arizona)	7	100	107					107	346,443
Humboldt	Charles Sheldon (see also Oregon)	475	40	515					515	581,709
Clark and Lincoln	Desert Game				320		[8] 320		320	2,022,000
Elko and White Pine	Ruby Lake		40	40					40	35,578
New Jersey: Atlantic	Brigantine	1,769	6,231	8,000					8,000	
New Mexico:										
Chaves	Bitter Lake	1,800	5,494	7,294					7,294	14,669
Socorro	Bosque del Apache		3,044	3,044					3,044	52,843
New York: Seneca	Montezuma	101	907	1,008					1,008	[2] 4,924
North Dakota:										
Foster and Stutsman	Arrowwood		34	34					34	[2] 13,303
Burke and Ward	Des Lacs		9	9	239		[3] 239		248	13,772
Ramsey	Lake Alice		12	12					12	
Dunn	Lake Ilo		2	2				[9] 6	8	
Burleigh and Kidder	Long Lake	240		240					240	7,051
Burke and Mountrail	Lostwood		6	6					6	23,401
Bottineau and McHenry	Lower Souris	938	480	1,418					1,418	57,036
Renville and Ward	Upper Souris	120	714	834	143		[3] 143		977	30,872
Rolette	Willow Lake		1	1					1	
Oregon:										
Lake	Charles Sheldon (see also Nevada)	627		627					627	
Lake	Hart Mountain	3,050	11,533	14,583					14,583	214,514
Harney	Malheur: Malheur Unit		15,069	15,069					15,069	93,487
South Carolina: Chesterfield	Carolina Sandhills				561	10,775	[4] 11,336		11,336	[2] 28,665
South Dakota:										
Charles Mix	Lake Andes		80	80					80	363
Brown	Sand Lake				268		[3] 268		268	19,476
Tennessee: Lake and Obion	Lake Isom		325	325	1,501		[3] 1,501		1,826	20
Texas: Aransas and Refugio	Aransas		1,344	1,344					1,344	53,917
Washington:										
Stevens and Pend Oreille	Little Pend Oreille					24,746	[4] 24,746		24,746	[2] 15,254
Skagit	Skagit		400	400					400	
Spokane	Turnbull	784	1,460	2,244					2,244	8,665
Pacific	Willapa Harbor	198	201	399					399	2,770

[1] $950,000 fund, a substitute for Executive Order No. 6724.
[2] Corrected since last year.
[3] Federal Emergency Relief Administration and Resettlement Administration funds.
[4] Acquired and in process of acquisition by the Farm Security Administration; originally intended for agricultural demonstration areas, but transferred to the Biological Survey.
[5] $1,000,000 fund provided through Executive Order No. 6724 of May 28, 1934.
[6] Set aside by Executive order or proclamation.
[7] Upper Mississippi River Wildlife and Fish Refuge fund.
[8] Miscellaneous fund.
[9] Acquired by gift.

TABLE 4.—Tracts, in acres, acquired or in process of acquisition for national wildlife refuges and related uses under the Migratory Bird Conservation Act, with emergency and other funds, and by gift and Executive order or proclamation—Continued

State and county	Refuge	Fiscal year 1940								Acquired in previous years
		Under Migratory Bird Conservation Act			With emergency and other funds			Acquired other than by purchase	Total	
		Acquired by purchase	Pending title conveyance	Total	Acquired by purchase	Pendin title conveyance	Total			
Wisconsin:										
Juneau	Necedah					37,436	[4] 37,436		37,436	[2] 2,564
Buffalo, Crawford, Grant, La Crosse, Trempealeau, and Vernon.	Upper Mississippi (see also Illinois, Iowa, and Minnesota).					321	[4] [7] 321		321	54,502
Wyoming: Teton	Elk Refuge	900	320	1,220					1,220	19,957
Total		21,717	115,151	136,868	19,852	93,979	113,831	59,455	310,154	[10]

[2] Corrected since last year.
[4] Acquired and in process of acquisition by the Farm Security Administration; orginally intended for agricultural demonstration areas, but transferred to the Biological Survey.
[7] Upper Mississippi River Wildlife and Fish Refuge fund.
[10] Total omitted, as entries in column are for only those refuges on which acquisition work was involved during the year.

NOTE.—1-acre items range from a fraction of an acre to 1,49 acres.

THE NATIONAL WILDLIFE REFUGE PROGRAM

The number of national wildlife refuges under the jurisdiction of the Biological Survey was increased by three, and much was accomplished in making the whole system more serviceable to wildlife. Under the improvement program, aided by C. C. C., W. P. A., and N. Y. A. labor agencies, a general increase was again noted in the number of birds and other wildlife using the refuges.

ADMINISTRATION AND MANAGEMENT OF REFUGES

The Biological Survey now administers 263 refuges (13,635,365 acres) (table 5), the 247 in the United States covering 9,541,163 acres and the 16 in Alaska, Hawaii, and Puerto Rico, 4,094,202 acres. It also administers 18 areas (12,417 acres) for experimental and administrative purposes, on which wildlife is protected.

The following 8 refuges (1,617,993 acres) were placed under active administration: Cabeza Prieta and Kofa, Ariz; Salton Sea, Calif.; Susquehanna, Md.; Brigantine, N. J.; and Lake Ilo, Lake Ardoch, and Long Lake, N. Dak. In addition, the 68 easement refuges in North Dakota (111,857 acres) were divided into districts and placed under the supervision of the personnel of 5 nearby refuges.

TABLE 5.—Classification and Acreage of National Wildlife Refuges Administered by the Bureau of Biological Survey

Classification	Number	Acres
For migratory waterfowl	176	3,447,218
For other migratory birds, small upland game, fur animals, and other wildlife	24	3,475,903
For colonial nongame birds	50	107,666
For big game	13	6,603,578
Total	263	13,635,365

Custodianship was assigned to the Biological Survey of six wildlife-management areas, former Resettlement Administration projects, covering 276,404 acres, in the following States: Minnesota (Beltrami Island), Missouri, New York, North Carolina, South Carolina (Carolina Sandhills), and Wisconsin (Necedah). Actual administration is under a State agency, usually the department of conservation, but the Biological Survey will serve in an advisory capacity and review wildlife-management plans before adopted.

At the end of the year, exclusive of the easement refuges, 91 refuges (10,648,620 acres) were being operated by a staff of 223 permanent and 32 part-time (temporary) employees. The cost of maintaining the refuges has increased materially with the placing of additional refuges under active administration, but even more with the comple-

tion of the C. C. C. and W. P. A. development work on several refuges, which necessitates maintenance from regular appropriations.

Bird Refuges

New refuges.—Three important refuges were added during the year—the Susquehanna Migratory Waterfowl Closed Area, Harford County, Md.; the Noxubee National Wildlife Refuge, Winston, Noxubee, and Oktibbeha Counties, Miss.; and the Bosque del Apache National Wildlife Refuge, Socorro County, N. Mex.

The Susquehanna area (21,210 acres) was closed under the Migratory Bird Treaty Act by Presidential proclamations of August 24, 1939, and January 24, 1940, to protect all forms of wildlife, especially canvasback and other ducks, which there find an excellent resting and feeding ground.

The Noxubee Refuge (about 40,000 acres) was established by Executive order of June 14, 1940, to protect wild turkeys, waterfowl, muskrats, and other wildlife.

The Bosque del Apache Refuge (55,972 acres) was established by Executive order of November 22, 1939, because of its value as a resting and feeding area for waterfowl during migration. Many birds spend the winter on the area and some nest there.

Increased use by wildlife.—The waterfowl and other wildlife on the national wildlife refuges showed a substantial increase in numbers for the fourth consecutive year, as a result of improved water, food, and cover conditions and more adequate protection. In addition, some species not seen on the refuges since their establishment were observed.

In North Dakota at least 150,000 ducks were produced on the Lower Souris Refuge, and 50,000 on the Des Lacs Refuge, in both cases substantial increases over previous years. For the first time since the establishment of the Lower Souris Refuge at least two pairs of wild unpinioned Canada geese, thought to be offspring of captives, nested there on artificial islands. The number of beavers on this refuge increased to 459 from the initial stock of 50 in 1935.

On the Sand Lake Refuge, S. Dak., more than 40,000 nests of Franklin's gull were found, compared with 20,000 in 1939, 6,100 in 1938, and 6,000 in 1937—the first year this species nested there—and at least 2,000,000 ducks stopped during the fall migration, a great increase over the previous years. On a floating island in the display pond a pair of wild Canada geese nested, the second nesting record since the establishment of this refuge, one brood having been hatched in 1939.

On the Mud Lake Refuge, Minn., 500 ruddy ducks nested, compared with about 50 each previous year since 1937, when the refuge was established.

The waterfowl stopping on the Necedah Refuge, Wis., during the spring migration was more than double the number present the previous spring. A maximum of 125,000 ducks wintered on the Savannah Refuge, Ga. and S. C. On the Muleshoe Refuge, Tex., the number of wintering ducks increased 400 percent and of Canada geese 250 percent over the previous year. Ten shoveler eggs on the Seney Refuge, Mich., provided not only the first nesting record of this duck for the refuge but probably for the entire Upper Peninsula.

On the Deer Flat Refuge, Idaho, at the peak of the fall migration there were about 200,000 pintails and 800,000 mallards, an increase of 100 percent over the preceding year. Snowy plovers seen on the Sacramento Refuge, Calif., established a new record for the refuge and its vicinity. Three new nesting records—western grebe, Brewster's egret, and white-faced glossy ibis—were established at the Salton Sea Refuge, Calif.

At the Bowdoin Refuge, Mont., three black ducks treated for botulism late in the summer gave the first observation of this species on the area; their occurrence in the vicinity is rare. The small herd of antelopes on this refuge, which numbered only 7 in 1935, was increased in 1939 to 27, when 10 fawns were born; the number born in 1940 is not yet known, but an increase of about 15 is indicated.

More than 1,300 geese of 4 species (Canada, white-fronted, lesser snow, and blue) remained all winter on the Lacassine Refuge, La., for the first time since its establishment. No accurate estimate could be made of the numbers of blue and snow geese that wintered on the Sabine Refuge, La., but on several areas closely packed flocks extended 1 mile long and 300 yards wide. There were flocks of blue and snow geese ranging from 40 to 200, on the Wheeler Refuge, Ala., during the fall migration, an unusual occurrence, since these birds rarely go so far east of the Mississippi Flyway. Canada and lesser snow geese were much more abundant on the Malheur Refuge, Oreg., in the fall than in previous years. Whistling swans stopped for the first time on the Bombay Hook Refuge, Del.

An encouraging increase in the number of trumpeter swans on the Red Rock Lakes Refuge, Mont., and its vicinity was revealed by a count made late in the summer of 1939. This showed for the refuge proper, 59 cygnets, or young birds, and 50 adults; for nearby lakes, 20 adults; and for the Yellowstone National Park, 17 cygnets and 53 adults—a total of 199 (76 cygnets and 123 adults), compared with 148 in the summer of 1938, and 158 in the summer of 1937.

Big-game Preserves and Ranges

The numbers of big-game animals on the Bureau's fenced preserves are given in table 6.

TABLE 6.—Animals on Fenced Big-game Preserves Maintained by the Bureau of Biological Survey (Estimated)

ANIMALS AS OF JUNE 30, 1940

Preserve	Buffalo	Elk	Antelope	Bighorn sheep	Deer		Texas longhorn	Total
					Whitetailed	Mule		
National Bison Range, Mont.	437	48	----	[1] 7	36	100	----	628
Fort Niobrara National Wildlife Refuge, Nebr.	148	37	----	----	8	5	24	222
Sullys Hill National Game Preserve, N. Dak.	13	14	----	----	16	----	----	43
Wichita Mountains Wildlife Refuge, Okla.	497	202	32	----	799	----	171	1,701
Total	1,095	301	32	7	859	105	195	2,594
YOUNG BORN IN CALENDAR YEAR 1939								
National Bison Range, Mont.	95	18	----	8	12	26	----	159
Fort Niobrara National Wildlife Refuge, Nebr.	30	11	----	----	2	----	4	47
Sullys Hill National Game Preserve, N. Dak.	7	8	----	----	2	----	----	17
Wichita Mountains Wildlife Refuge, Okla.	112	30	7	----	50	----	27	226
Total	244	67	7	8	66	26	31	449

[1] All but this number were transferred to the Hart Mountain Antelope Refuge, Oreg.

Kofa and Cabeza Prieta Game Ranges, Ariz.—The desert grasses and shrubs on these ranges were in the best condition they have been for many years, following plentiful fall and winter precipitation. Water was available for all wildlife using the Kofa Range, but the supply on the Cabeza Prieta Range was not adequate. Numerous bighorn sheep were seen regularly on these ranges, but no accurate estimate of their numbers could be made. Gambel's quails were abundant, and coveys could be seen at the watering places at almost any time.

National Bison Range, Mont.—Of the 54 bighorn sheep on this range at the beginning of the year, 25 were transferred to the Hart Mountain Refuge, Oreg., which is believed to provide the species a more suitable habitat.

Desert Game Range, Nev.—About 350 bighorn sheep and 175 deer were estimated to be on this area at the end of the year. Conditions for the big game were excellent. Since the range was established 47 species of mammals and 66 of birds have been recorded.

Sheldon National Antelope Refuge, Nev.—Considerable rainfall during the spring months resulted in a good growth of browse for the

antelope and other animals, and at the close of the year there were on the refuge about 1,200 antelopes, including about 400 fawns, approximately 300 mule deer, 250 wild horses, and large numbers of sage hens.

Wichita Mountains Wildlife Refuge, Okla.—Spring rains on this refuge put the range in much better condition than in most years and brought up water levels in the lakes, which had been greatly lowered during the acute drought in the preceding summer and fall, when it was necessary to release water from Rush, Jed Johnson, and Elmer Thomas Lakes to supply Fort Sill and the city of Lawton. In January, 24 antelopes were received from New Mexico in exchange for the same number of elk. They appear to have acclimated themselves satisfactorily. With additional range made available by the curtailment of grazing by domestic stock, the longhorn cattle herd was permitted to increase slightly and numbered 171 at the end of the year, compared with 149 in 1939.

National Elk Refuge, Wyo.—Although no official enumeration of the elk in the Jackson Hole herd has been made since the spring of 1938, when 17,370 were counted, of which 7,782 were on the refuge, it was estimated that at least 9,000 spent the past winter on the area. Weather conditions were such that it was not necessary to feed them hay, and few losses occurred.

DEVELOPMENT OF REFUGES

Engineering Work

During the fiscal year, projects involving engineering work and inspection were undertaken on 72 refuges, the actual construction being done by C. C. C. and W. P. A. labor. Preliminary surveys were made on 29 refuges, and construction plans were drawn up for 32. In addition, technical information of use in the administration of the Federal Aid to Wildlife Restoration Act was developed and the engineering feasibility of a number of proposed refuges was investigated.

As in previous years, one hydraulic engineer attended to the filing of water rights and the protection of water supplies and negotiated with various Federal and State agencies on matters involving the use of water on or affecting the wildlife refuges. He was one of three engineers who represented the United States on the Souris River water adjudication and conferred with Canadian representatives on the distribution of the water of this international stream, on which three of the Biological Survey refuges in North Dakota are situated.

Biological Development

Food and cover.—In the marsh and aquatic planting program, 200,000 pounds of seeds, tubers, and rootstocks were collected within the refuge system, to meet the needs for biological rehabilitation of newly acquired areas and to hasten natural recovery on lands mismanaged by former owners. Improved seed-collecting technique and abundant crops combined in some instances to provide supplies somewhat in excess of immediate needs and permitted the distribution of material to other public agencies for use in wildlife-habitat improvement.

In the development of upland-game habitat, 1,250,000 trees, shrubs, and vines were used, part of which were made available through the cooperation of the Soil Conservation Service, Tennessee Valley Authority, Forest Service, and State conservation departments. About 3,000 pounds of tree and shrub seeds were collected for the propagation of wildlife food and cover plants needed for future development work, some of which were turned over to other agencies for propagation under growing agreements. For improvement of big-game ranges where intense utilization had reduced the forage supply, 12,000 pounds of seed, collected mostly within the refuge system, were used. To establish supplementary feed patches, 14,000 pounds of seeds of legumes and other food plants were sown on quail and turkey management sites.

About 30,000 acres of land were cultivated by sharecroppers, under agreements, and by refuge personnel to provide supplementary food for wildlife during critical periods and to aid in sustaining increasing wildlife populations. A large percentage of this acreage was sown to forage crops for geese. On a 5-acre field of millet and buckwheat planted on the Tamarac Refuge, Minn., 33 pheasants, 6 prairie chickens, 12 ducks, 1 Canada goose, and 11 white-tailed deer were seen feeding at one time.

Controlled burning.—The recognized importance of controlled burning in marsh management for waterfowl has led to an increased use of fire on coastal areas where field investigations indicate that this practice will be of greatest value. The importance of controlled burning in certain types of marsh vegetation is indicated by the fact that more than 100,000 blue and lesser snow geese fed extensively on burned areas on the Sabine Refuge, La., which they had previously avoided. Extensive field observations were carried on to obtain additional data on the several interrelated factors involved. Controlled burning was also practiced on several hundred acres of land lying within upland-game management demonstration units.

Control of noxious aquatics.—Factors favoring the development of an optimum waterfowl habitat also permit the growth of noxious plants that tend to supplant those of high value to wildlife and thereby minimize the utility of the area. Where the problem exists, control measures have been undertaken with noteworthy success, particularly in the reduction of cattails. Special equipment is being developed for future work of this nature.

Cover management.—The rapid response to habitat-improvement work on refuges is reflected in increasing wildlife populations, which in several instances have permitted the removal of mature breeding stock for restocking public lands. From the Sand Lake Refuge, S. Dak., 1,830 pheasants were distributed to 6 counties for restocking under the direction of conservation officials of that State. Surplus deer and raccoons also were released to various State conservation departments for restocking depleted coverts.

Nesting.—The design of boxes for tree-nesting ducks was improved on the basis of field investigations of their use. Artificial nesting boxes have produced a material increase in breeding wood ducks and goldeneyes, and 750 new ones were constructed and installed, and many old ones reconditioned. To provide essential habitat features for waterfowl and shorebirds in new impoundments, 49 additional nesting islands were constructed.

Winter feeding.—During severe winter weather, when it becomes necessary to provide grain for birds unable to find food because of ice and snow, not only is feeding done on the refuges but elsewhere in cooperation with local agencies. Some of the grain used is raised on the refuges, some is purchased, and some is donated by other agencies—Federal, State, or private. Through the cooperation of the Bureau of Agricultural Economics, 10,896 bushels of mixed grains were obtained from 12 grain-inspection stations.

The severe winter of 1939–40 made it necessary to do more feeding than usual. On and adjacent to the Brigantine Refuge, N. J., about 2 tons of grain were distributed daily to some 600 black ducks and other birds, much of it, quickly and effectively, by means of an airplane. Considerable feeding also was done on the White River Refuge, Ark.

Civilian Conservation Corps Development on Refuges

Work accomplishments.—The C. C. C. continued to have an important part in the long-range program of developing waterfowl and other game refuges. There were C. C. C. camps on 41 National and 1 State wildlife refuge in 26 States. The number of full-strength camps averaged approximately 35, and 1 side camp was used. Among

8 new camps, the one at the Ogden Bay State Refuge, Utah, is especially noteworthy because it is the first C. C. C. activity by the aid of which a State will directly participate under the provisions of the Federal Aid to Wildlife Restoration Act. Work programs were completed by 5 camps, making 20 in all that have finished the development work assigned to them by the Survey. Enrollees detailed by other services worked on 8 other refuges, making a total of 16 refuges improved by C. C. C. enrollees working from side camps or on special details.

The development work differed in each locality because of wide variances in soil and water conditions and their influences upon food and cover vegetation but was of the same nature as outlined in previous reports. The following few accomplishments indicate its scope: More than 240 miles of truck and patrol trails, 26 bridges, 70 miles of telephone lines, 80,908 rods of fences, 11 lookout towers, 18 dwellings, 6 overnight cabins, and more than 50 barns, garages, and other service buildings were constructed to enable the personnel to administer the refuges and maintain the sanctuary status effectively and economically. To provide favorable water conditions for wildlife, the enrollees built 8 large diversion dams; moved more than 1,700,000 cubic yards of earth in constructing dikes and levees; excavated more than 660,000 cubic yards of earth and rock to provide 21,570 lineal feet of ditches and canals; built 14 small reservoirs and 96 permanent check dams; cleared and cleaned debris and undesirable growths from approximately 560,000 square yards of water channels and 1,180 acres of lake and pond sites; and built 83 spillways and other water-control structures. They planted desirable food and cover vegetation on 4,696 acres.

Job-training and educational programs.—In the development work on the refuges thousands of enrollees are given practical training and instruction both in classroom and field, the training being practical rather than theoretical, because classroom work is supplemental to field training, which in turn is supplemental to actual field work, where more than 1,100 trucks, tractors, trail builders, graders, draglines, and other pieces of equipment were used by enrollees under skilled supervision. Of the 610,000 enrollee training hours, about 300,000 were given to instruction in truck, tractor, and dragline operation and repair; welding; surveying; the handling of dynamite; and the construction of roads, bridges, and buildings.

Safety program.—The safety program is closely correlated with the training program and is so emphasized that the accident-frequency record for 1940 was better than ever. The 1.35 accidents per 10,000 man-days of work in 1939 dropped to 1.13; that is, there were 1,054,920

man-days of labor with only 119 lost-time accidents, a decrease of 24 accidents from last year. At the close of the year, 8 camps had operated without a lost-time accident for 12 months or more, 1 of these, the Tule Lake camp, California, for 29 consecutive months. Three fatalities marred an otherwise satisfactory record.

Cooperation With the Work Projects Administration

The development of refuges by the W. P. A. was continued on 45 areas in 16 States, for which Federal W. P. A. allotments of $831,298 were made available to the Biological Survey and provided approximately 13,675 man-months of employment. In addition, 23 Bureau-sponsored State projects were approved, for which Federal W. P. A. funds of $865,676 were supplemented by $298,490 from the Bureau for the purchase of materials and supplies and for furnishing equipment and supervision.

The emergency relief funds received from the W. P. A. not only enabled the Biological Survey to continue important development phases of its national wildlife-restoration program but also provided useful work for persons in need of relief. The great variety of work done included the construction of dams, dikes, and ditches for impounding water and creating marshes and the installation of structures for controlling water levels for the production of wildlife food and cover. Aquatic and upland vegetation, shrubs, and trees were planted to provide supplementary food and cover, reduce soil erosion, and assist in the prevention of floods. Nesting islands and upland-game shelters of various types were built, fences erected, refuge boundaries posted and marked, and roads and fire lines constructed or rebuilt. In several cases administration buildings were constructed and landscaped.

Federal W. P. A. funds totaling $119,030, supplemented by Bureau contributions of $32,136, provided 1,488 man-months of employment of statistical and clerical help to assist in bringing old work to date.

Inspection of proposed drainage projects.—In furtherance of a cooperative understanding, 202 applications submitted to the W. P. A. for drainage projects (most of which were State- or county-wide in character) were referred to the Bureau for review as to their probable effect on wildlife. Of these projects, 89 (538 units) were concerned with agricultural drainage for flood control and land utilization, and 113 (415 units) involved pest and malaria-mosquito control.

Of the 953 work units involved, 38 that threatened to be unnecessarily detrimental to wildlife were disapproved as recommended by the Bureau, 203 were recommended for partial or conditional ap-

proval, with the proviso that the plans be so modified as not to menace wildlife; and the remaining 712, which did not involve wildlife values, were recommended for unconditional approval. In the projects concerned with land-utilization drainage, practices were recommended and carried out that assured stabilized water levels and the least possible damage to wildlife; and in the mosquito-control drainage projects, wherever practicable, methods of mosquito reduction through impoundment and water control rather than mechanical drainage were recommended and effected. In this manner, appreciable acreages of wildlife habitat were saved from destruction.

National Youth Administration Assistance

The Biological Survey was fortunate in again having N. Y. A. labor available for research projects and other refuge work not suitable for C. C. C. and W. P. A. labor. It was utilized on most of the 68 North Dakota easement refuges; on the Moosehorn Refuge, Maine; Seney Refuge, Mich.; Tamarac Refuge, Minn.; Arrowwood and Des Lacs Refuges, N. Dak.; and Sand Lake and Waubay Refuges, S. Dak. The projects thus accomplished included constructing small boats, trailers, picnic tables and benches, office equipment, and snow fences; repairing and improving roads and fences; planting and cultivating lawns and tree and shrub plots; collecting and planting aquatic seeds; brush burning; patrolling; constructing banding traps, shelters, and nesting boxes; and making nesting studies and wildlife enumerations.

PUBLIC USE OF REFUGES

Economic Uses

In disposing of surplus products on some of the national wildlife refuges, there were issued 167 permits for cutting approximately 10,276 tons of various kinds of hay and 183 grazing permits covering approximately 107,093 animal months' use by 17,755 cattle, 12,659 sheep, 288 horses, and 75 hogs. Care was taken to safeguard the interests of wildlife. Before impounding water in timbered areas on some of the refuges it is first necessary to cut trees and brush from areas to be flooded. To 294 permittees, living mostly in the immediate vicinity of the refuges, who needed the wood for fuel, 6,500 cords of such surplus timber were given. To provide supplementary food for wildlife, 319 farmers cooperated with the Bureau in planting 27,829 acres of refuge land to grain crops on a share-crop basis.

Permission was granted to 286 permittees for such miscellaneous uses of refuge lands as harvesting hay; keeping bees; picking fruit; operating and maintaining stock driveways across refuge lands for

watering cattle; erecting, maintaining, and using buildings; and constructing power and telephone lines, roads, and ditches.

In the course of the regular effort to prevent increase of the herds to a point where they will overgraze the range, 184 buffaloes and 54 elk, 4 mule deer, 1 white-tailed deer, and 8 longhorn cattle were removed. These were either sold or donated for butchering or for exhibition and propagation.

The total revenue received for the use of refuge lands and from the sale of surplus big-game animals and other refuge products was $75,845.28. In accordance with the law, 25 percent of this was turned over to the counties in which the refuges are situated and the remainder deposited in the Federal Treasury.

Recreational Facilities

In addition to the many people taking advantage of opportunities afforded on the wildlife refuges for recreation, such as picnicking, swimming, boating, fishing, and hunting (on 7 refuges only), thousands annually visit the areas to learn more about the conservation work being done. As many as 400 persons visited the Waubay Refuge, S. Dak., on Sundays during the summer, and more than 6,000 picnicked on or otherwise used the recreational area on the Moosehorn Refuge, Maine, during July. Each winter thousands of people visit the National Elk Refuge, Wyo., to see the elk concentrated on their feeding grounds.

Fishing is permitted on specified parts of many of the refuges when it is determined that it will not interfere with the wildlife. Eight orders designating fishing areas were issued during the year. More than 500 persons fished on the Squaw Creek Refuge, Mo., on the opening day of the season, and during 4 months 9,034 fishermen on the Chautauqua Refuge, Ill., took 116,471 fishes.

ADMINISTRATION OF WILDLIFE CONSERVATION LAWS

The principal Federal statutes administered by the Biological Survey for the conservation and restoration of wildlife are (1) the Lacey Act of 1900, as amended, regulating shipments in interstate and foreign commerce of wild animals, their dead bodies, or parts thereof, and the importation of live birds and mammals from foreign countries; (2) the Migratory Bird Treaty Act of 1918, protecting birds that migrate between the United States and Canada, as amended to extend its provisions to the treaty of 1937 protecting birds that migrate between the United States and Mexico, and regulating the movement of game mammals and parts thereof between the two countries; (3) the Migratory Bird Conservation Act of 1929, authorizing the establishment of

bird refuges; (4) the Migratory Bird Hunting Stamp Act of 1934, as amended, to aid in refuge establishment; (5) the Federal Aid to Wildlife Restoration Act of 1937; (6) a law (sec. 84, Criminal Code) protecting wildlife and Government property on Federal refuges; (7) through the Alaska Game Commission, the Alaska Game Law of 1925, as amended; and (8) the Bald Eagle Act, approved June 8, 1940, extending Federal protection to the bald eagle in the United States or any place subject to its jurisdiction, except in Alaska.

REGULATORY ACTION

The Migratory Bird Treaty Act regulations were amended in a very few particulars, the length of open seasons on waterfowl, coot, and Wilson's snipe being retained at 45 days, but opening in the intermediate zone on October 22 instead of October 15 as in 1938, and the possession limit on woodcock being changed from 4 birds to not more than 2 days' bag limit. Publications relating to conservation laws included a processed abstract of State fur laws affecting trapping seasons, possession, and the sale and shipment of pelts (Leaflet BS–147) and Wildlife Circular 2, the annual directory of game-protection officials. Amendments to the regulations under the Alaska game law were published in Alaska Game Commission Circular AGC–18. Conferences with representatives of State game departments on conditions affecting the conservation and hunting of migratory game birds were a great aid in drafting the hunting regulations for the 1940 season.[2]

WORK OF GAME-MANAGEMENT AGENTS

The 46 game-management agents and 19 deputy agents, singly or in cooperation with State officers and deputy game wardens, obtained evidence in 2,939 cases of game-law violations. Prosecuted in State and Federal courts, these resulted in 2,773 convictions as given in table 8 (p. 279).

Because of the hazardous nature of the duties of the game-management agents the Civil Service Commission on June 17, 1940, assigned them to the 62-year-age retirement group. To further game protection, the agents conducted film and radio programs, addressed schools, civic organizations, and sportsmen's clubs, issued statements through the press, and assisted locally on other lines of Bureau investigations. Results of their enforcement activities are exemplified in the following migratory game bird cases:

[2] Regulations for 1940, adopted by the Secretary of the Interior on August 2, were approved and proclaimed by the President on August 9 (5 F. R. 2813)

In Tennessee, a defendant was fined $500 and $50 costs for shooting mourning doves in a baited field.

In Louisiana, one alleged duck bootlegger was given a 75-day and another a 65-day jail sentence.

In Arkansas, for hunting ducks in close season, two defendants were each sentenced to 30 days in jail and fined $150.

In North Carolina, a defendant was given a 4-month jail sentence for selling wild geese; another, charged with killing wild geese during close season, was given 60 days.

In Michigan, killing and possessing whistling swans brought a sentence of 30 days in jail and a fine of $400.

In Nevada, two violators were each fined $250 for killing ducks from a motorboat.

In Ohio, conviction on a charge of trapping ducks brought a fine of $300 and $23 costs, and a 3-month suspended jail sentence.

In Virginia, for selling wild ducks, a duck bootlegger was fined $500.

Under-cover Operations

Out of current appropriations for the protection of migratory birds, the Secretary is authorized to expend at his discretion not to exceed $10,000 for obtaining information concerning violations of Federal game laws. The expenditure of $3,850.54 of this authorization in under-cover operations produced evidence obtained by game-management agents against many unlawful commercial dealers in game who otherwise might not have been apprehended. In addition to successfully conducted under-cover investigations in Louisiana, Maryland, Minnesota, Texas, Virginia, and Wisconsin, the results in the following States were outstanding:

In Tennessee, Arkansas, and Mississippi, 110 sellers or buyers of migratory waterfowl and other game birds were given an aggregate sentence of $4,573 in fines and 216 days in jail.

In the San Francisco-Sacramento area, California, excellent cooperation by United States attorneys and Federal judges resulted in the conviction of 48 dealers in wild fowl, 3 of whom were fined $500 each, 3, $250 each, and the rest were given smaller fines and jail sentences ranging from 30 days to 9 months, the fines aggregating $3,315 and the jail sentences 57 months.

Of 9 persons apprehended for dealing in migratory wild fowl in southern California, 4 were placed on probation for 1 year each.

In Iowa, duck bootlegging cost one violator a fine of $250 and $37.50 costs, and another $125 and $36.25 costs.

Apprehensions Under Various Statutes

Migratory Bird Treaty Act cases.—Of 829 new cases filed in Federal courts and 273 pending from the preceding year, 833 were disposed of with 666 convictions (table 7)—a decrease from the preceding year of 32 new cases and of 19 cases terminated but an increase of 18 convictions. Fines, ranging from 1 cent to $500 and costs, aggregated $19,656.64, fines totaling $1,060 having been suspended in 22 cases. Jail sentences aggregated 3,321 days in 42 cases; suspended sentences, 891 days in 9 cases; and probation terms, 2,281 months in 84 cases.

TABLE 7.—Cases of Violation of the Migratory Bird Treaty Act Disposed of During the Year and Cases Still Pending on June 30, 1940

Disposed of	Number	Pending	Number
Convictions	666	From preceding year	273
Dismissals	48	New cases	829
Nol-prossed	42		
Jury trial, not guilty	18	Total	1,102
Closed without prosecution	18	Disposed of	833
No bill	38		
Closed by death	2	Pending at end of year	269
Dropped with leave to reinstate	1		
Total	833		

Migratory Bird Conservation Act cases.—Of 27 new cases and 16 pending from the preceding year, 38 were closed as follows: Thirty-four brought convictions, 3 were nol-prossed, and 1 was adjudged not guilty. The 34 sentences imposed aggregated $1,160 in fines, 475 days in jail, and 6 months' jail sentence suspended, and 7 years and 1 day probation.

Migratory Bird Hunting Stamp Act cases.—Of 63 new cases and 30 pending from the preceding year, 70 were disposed of as follows: Four were closed without prosecution, 4 were dismissed, 1 was nol-prossed, 3 were found not guilty; fines aggregating $481 and $37.10 costs were assessed in 37, and 1 fine of $25 was suspended; defendants in 2 cases were each sentenced to 15 days in jail and in 6 were each given 1 year's probation; and in 12 cases the accused were found guilty but were assessed penalties by the court upon counts charging violations of the Migratory Bird Treaty Act regulations.

Wildlife Refuge Trespass Act cases.—Of 8 new cases and 5 cases pending from the preceding year, 11 were closed, 1 being nol-prossed and 10 receiving convictions, an aggregate of 110 jail days being imposed in 7 cases; fines of $105 in 2; and a year's probation in 1.

Upper Mississippi River Refuge cases.—Of 27 new cases and 20 pending from the preceding year, 24 were terminated, as follows: Convictions were obtained in 22, the fines aggregating $125, suspended jail sentences 4 years and 10 months, and probations 26 years; 1 was nol-prossed; and 1 was closed without prosecution.

Lacey Act cases.—The 10 new cases and 2 cases pending from the preceding year were terminated, by convictions in 10, with fines aggregating $220, by dismissal in 1, and by failure of the grand jury to return a true bill in 1. Agents making inspections under this statute in fur-receiving centers discovered information relating to possible infractions of State game or fur laws. Invoices relating to 1,658 shipments of pelts were sent to game-protection officials in the various States, Alaska, and Canada and disclosed 241 law violations that were terminated in State courts by fines and costs aggregating $5,633.83.

Other cooperation with States.—Evidence regarding 1,752 cases involving violations other than illegal shipments of skins of fur animals were handled in 42 States, where fines and costs aggregated $57,515.87 and jail sentences (91), 5,369 days. Investigations by State wardens and game-management agents working together broke up many commercial groups operating unlawfully in fur and game. In some instances State and Federal officers operated patrol boats jointly.

TABLE 8.—Summary of Penalties Imposed for Game-Law Violations, Fiscal Year 1940

Act or law	Convictions (number)	Fines and costs	Jail sentences (days)
Migratory Bird Treaty Act	666	$19,656.64	3,321
Migratory Bird Conservation Act	34	1,160.00	475
Migratory Bird Hunting Stamp Act	38	518.10	----------
Wildlife Refuge Trespass Act	10	105.00	110
Upper Mississippi River Wildlife and Fish Refuge Act	22	125.00	----------
Lacey Act	10	220.00	----------
State prosecutions resulting from Lacey Act investigations	241	5,633.83	----------
State laws, cooperative prosecutions	1,752	57,515.87	5,369
Total	2,773	84,934.44	9,275

IMPORTATION AND OTHER PERMITS ISSUED

REGULATIONS

Treasury regulations were amended at the request of the Department of the Interior to require a permit for the importation of any number of canaries. The former privilege of allowing five to be entered without permit was often abused, other species being entered under the guise of canaries when the customs inspectors were unable to identify the birds. The regulations were further amended to limit to three the number of parrots or birds of the parrot family that may be entered without permit, in order to conform this regulation in this respect to the regulations of the Public Health Service.

SPECIES EXCLUDED

A few attempts to import prohibited species, including crested mynas (*Aethiopsar cristatellus*) and skylarks (*Alauda arvensis*), were detected by inspectors and frustrated. Applications for permits to import as cage birds several species of migratory birds from Mexico, Cuba, and Central America continued to be received but were refused. Quite frequently, ignorantly or deliberately, attempts are made to import migratory birds, especially of the sparrow and bunting types, as canaries. One mongoose, brought by a passenger from Africa, arrived at the port of New York on February 19. Denied entry by Customs officers, it remained aboard the steamer until chloroformed on March 2.

SPECIES ENTERED UNDER PERMIT

The number of importation permits issued was 1,492, including 18 at Honolulu, Hawaii; and 272 importations were inspected.

Birds

Foreign birds imported into continental United States, a total of 252,153, compared with 252,628 last year, included 135,287 canaries, 125 parrots, 85,995 Mexican quails, 3,081 Hungarian partridges, 897 pheasants, and 26,768 miscellaneous birds. At Honolulu, 255 foreign birds were entered, compared with 492 last year.

After the outbreak of the European war in September, large shipments of canaries for the United States were routed via Holland and Belgium instead of direct from Germany. From then on only one shipment of Hungarian partridges (2,400) was imported from Europe, compared with several large shipments the previous year. About 681 Hungarian partridges raised by breeders were brought in from Canada.

The first shipment of bobwhites from Mexico (2,800) arrived as early as December 2, the next, however, not until January 13. Thereafter and until the end of the season on April 15, the birds came in steadily in large consignments. The total number imported was 85,995, compared with 87,457 last year, of which 2,250 were entered at Brownsville, 5,800 at Eagle Pass, and 77,945 at Laredo, Tex. Imported for stocking purposes, most of these birds were distributed in Texas, Indiana, Kentucky, and Mississippi, but small lots were sent to 18 other States and the District of Columbia.

Among the more interesting pheasants imported were 8 Siamese fire-back pheasants (*Diardigallus diardi*), from Singapore; 12 copper pheasants (*Syrmaticus soemmerringii*), from Japan; 1 argus pheasant (*Argusianus argus*), from the East Indies; and 1 Swinhoe pheasant (*Hierophasis swinhoii*) and 1 Elliot pheasant (*Calophasis ellioti*), in a shipment from Canada.

In addition to the requirement of an importation permit from this Department and in some cases State permits, the entry of birds of the parrot family continues to be subject to the regulations of the Public Health Service. Among the more interesting parrots imported were 4 Kuhl lories (*Vini kuhlii*) and 2 Society Island lories (*Vini peruviana*), from Papeete, Tahiti.

Other interesting importations were 2 Falkland robins (*Turdus falklandicus*), 2 Chilean lapwings (*Belonopterus chilensis chilensis*), 2 Chilean sparrow hawks (*Cerchneis sparveria cinnamomina*), 6 chingolos (*Brachyspiza capensis*), and 4 guans (*Ortalis* sp.), from Chile; 7 chungas (*Chunga burmeisteri*), from Argentina; 2 Pacific pigeons (*Globicera pacifica*), from the Fiji Islands; 1 European jay (*Garrulus glandarius*), in a shipment from Japan; 6 crocodile plovers (*Pluvianus aegyptius aegyptius*), from England; 7 lesser double-collared sunbirds (*Cinnyris chalybea*), 1 Malachite sunbird (*Nectar-*

inia famosa), 1 Livingstone's touraco (*Turacus livingstonii*), 2 Hadada ibises (*Hagedashia hagedash*), 1 crowned hawk eagle (*Stephanoaetus coronatus*), 1 northern lizard buzzard (*Kaupifalco monogrammicus*), and 1 yellow-casqued hornbill (*Ceratogymna elata*), from Africa.

Mammals

Importations of black bear cubs from Canada, mostly destined for roadside menageries, were fewer than usual. The total number was 92, compared with 137 last year. Rhesus monkeys, imported chiefly as experimental subjects for human diseases, totaled 10,146, compared with 12,536 last year. Among other interesting mammals were 2 giant pandas (*Aeluropoda melanoleuca*), from China, 1 in September for the St. Louis Zoo and 1 in November for Chicago's Brookfield Zoo. Other rare and interesting animals included 1 potto (*Perodicticus potto*) and 2 Gambian pouched rats (*Cricetomys gambianus*), from Liberia; 1 crab-eating seal (*Lobodon carcinophaga*), from Palmer Land, Antarctic Archipelago; 1 murine opossum (*Marmosa elegans*) and 1 Azara's fox (*Pseudalopex gymnocereus*), from Chile; 1 manatee (*Trichechus inunguis*), from Brazil; 3 Tasmanian devils (*Sarcophilus harrisii*), from Australia; and 2 Arctic foxes (*Alopex lagopus*), in a shipment from Belgium.

PERMITS UNDER THE MIGRATORY BIRD TREATY ACT

For Scientific Purposes

To take migratory birds or their eggs for scientific purposes, 447 permits (general or under specific limitation) were issued and 1,753 were outstanding at the close of the year. Permits of similar limitation to possess migratory birds or their eggs, lawfully acquired for scientific purposes, were issued to 56 persons, and 564 were outstanding at the close of the year. Others issued were 167 for possession of one or a few specimens found dead; 155 for banding migratory birds; and 43 for taking birds and mammals in Alaska.

For Propagation

Permits to take migratory waterfowl for propagation were issued to 30 persons, each permit limiting the species and the number of individuals of each and the time to be taken. To possess migratory waterfowl lawfully acquired for propagating purposes, 319 permits were issued. At the close of the year 3,788 propagating permits were outstanding. Failure of permittees to render the required annual reports or to surrender their permits upon discontinuing operations resulted in 331 permits being recalled, canceled, or revoked.

Reports submitted by permittees disclose that 3,820 wild geese and 74,708 wild ducks were raised in captivity. Of these, 71,674 were mallards, 958 black ducks, 925 wood ducks, and the remainder principally teals, pintails, ringnecks, wigeons, and redheads. Sales of propagated migratory waterfowl included 15,075 ducks and 350 geese for food and 17,411 ducks and 1,224 geese for propagation. From propagating stock, 8 swans, 192 mourning doves, and 11 band-tailed pigeons were produced. Of propagated birds, 15,667 ducks, 360 geese, and 66 mourning doves were liberated.

For Depredation Control

To enable permittees to protect crops, fishes, and other property from serious depredations by migratory birds, 506 permits were issued. Many complaints of depredations were investigated and suggestions and aid given for relief without the necessity of killing the birds.

COOPERATIVE CONTROL OF INJURIOUS ANIMALS

Cooperative work in predator and rodent control entailed an expenditure of $687,203 from departmental funds, $475,644 from cooperating States, $1,085,540 from cooperating counties, livestock associations, and others, and about $536,698 from emergency funds. In these operations 116,805 predatory animals were taken, consisting of 104,072 coyotes, 1,355 wolves, 10,556 bobcats and lynxes, 608 predatory bears, and 214 mountain lions. Through W. P. A. cooperation in Montana, Utah, Oregon, and Idaho, W. P. A. hunters working under direct Bureau supervision ably supplemented the regular predator-control work. To reduce infestations of prairie dogs, ground squirrels, pocket gophers, jack rabbits, field mice, and other injurious rodents, treatment of 12,174,125 acres was supervised. In addition, without direct supervision but under general instructions of the Bureau fieldmen, approximately 20,659,759 acres were treated for the control of field rodents and, in cooperative campaigns for the eradication of the common rat, 198,902 premises were treated. The Bureau's supply depot at Pocatello, Idaho, prepared and distributed to cooperators in all parts of the country 1,822,085 pounds of rodent bait materials, as well as equipment for use in predator and rodent control.

PREDATORY-ANIMAL CONTROL

In harmony with established policy, predatory-animal control projects for the protection of livestock, poultry, and game were conducted only in areas where there was pressing need. The coyote is the chief subject to control, as it is responsible for a greater total loss to live-

stock and poultry than all other predators combined, and has markedly increased in the last 10 years in most sections of the West and is becoming established locally in the East. In the southwestern mountains and forests it is apparently increasingly skillful as a killer of both game and livestock. In many States where the game departments are seeking to develop suitable game areas predators interfere seriously with the increase and, in some instances, the survival of desirable species.

To curtail the spread of rabies and other canine-borne diseases required coyote control in some areas. A serious outbreak of rabies among coyotes in Pima and Santa Cruz Counties, Ariz., during July 1939 spread to domestic dogs and as a result several people were bitten and 16 were given the Pasteur treatment. Predator control was inaugurated after a fall and winter outbreak of anthrax in livestock in Beaverhead County, Mont., where coyotes were found to be feeding on the diseased carcasses and carrying parts of them to other localities, thus spreading the disease.

Cases of Predation

Following are a few representative instances of the many cases of losses occasioned by predatory animals during the year:

Coyotes.—One operator in Skull Valley, Ariz., lost 250 goats during 2 fall months. On a ranch in Hudspeth County, Tex., 1 male coyote taken by a Bureau hunter had killed 100 Angora goats within a short period. During January, February, and March, 31 buck deer were killed by coyotes on a ranch in southern Texas. A rancher near Buffalo, Wyo., lost 75 turkeys to coyotes in 1 night. Close observation demonstrated that coyotes destroyed 40 sage grouse near a water reservoir in Johnson County, Wyo., an area particularly adaptable to grouse and on which the State Fish and Game Commission is attempting to establish them. One sheepman in western Salt Lake County, Utah, lost 250 lambs to coyotes in less than a month, and one in Grant County, N. Dak., lost 125 from his flock of 500 sheep during the year. That coyotes occasionally injure crops also is shown by recent requests for assistance from southern California where the animals were inflicting severe damage to watermelons and avocados.

Wolves.—Within 3 months 1 red wolf destroyed 200 lambs on a ranch in McCulloch County, Tex. Bureau observers in Alaska report wolves more abundant than for the past 20 years and their depredations especially heavy on mountain sheep, caribou, and moose in the Mount Hayes section. Wolf predation in three parishes of north-central Louisiana became so severe by 1939 that the local cattle-and-hog industry was practically forced out of existence.

Other predators.—Bobcats are defeating the introduction and propagation program for wild turkeys and deer on the Pearl River County and Leroy Percy State Game Refuges in Mississippi, according to reports from the Mississippi State Game and Fish Commission. On a ranch near Ellensburg, Wash., a mountain lion stampeded a flock of sheep in a brushy canyon, killing 3 outright and causing the death of 52 others in the stampede pile-up. On a ranch in Hudspeth County, Tex., a female mountain lion killed 50 sheep within a few weeks.

Peg-legged predators.—Studies of food habits reveal that peg-legged, or trap-crippled, predators are more devastating to livestock than are normal individuals. Apparently this is because they are less capable of catching wild fleet-footed quarry and therefore prey more heavily upon young livestock. One male coyote that had lost two toes in a trap killed 26 yearling lambs valued at $8 each in Fisher County, Tex., within a period of 30 days. Poor trapping technique aggravates the problem of control, and the employment of expert trappers is in line with efficient, economical, and humane procedure.

Benefits of Predator Control

A sheep operator in the vicinity of Rock Springs, Wyo., reported that as a result of the Bureau's predator-control activities his livestock losses were reduced from 10 to 3 percent. At the request of the Arizona Woolgrowers' Association a hunter was assigned to each of the sheep driveways during July to trap out concentrations of coyotes before the annual trek to winter pasture began. As a result, no serious losses were reported along the trail, whereas losses previously ran as high as 15 percent.

Coyote-control operations in Presidio County, Tex., resulted in a 40-percent increase in the antelope herd on one range. In a suburban area near Portland, Oreg., where coyotes were causing serious losses to small flocks of sheep and poultry, after 5 coyotes were taken there were no more losses. A hunter took 8 old killer coyotes in Stutsman County, N. Dak., and thus ended further depredations where small stockmen were being forced out of business.

Depredations on cattle and sheep in Winn Parish, La., were curtailed when a Bureau hunter took a 92-pound wolf and 3 smaller ones. After a 4-year pursuit a Bureau hunter, in Laclede County, Mo., took a destructive wolf to which one stockman alone had lost $800 worth of sheep, and whose depredations had been so severe generally that the county government and local stockmen had offered a bounty of $140 for its capture.

RODENT CONTROL

Damage in the West by ground squirrels, prairie dogs, kangaroo rats, pocket gophers, and other field rodents continued to be severe on crops, range vegetation, and silvicultural plantings. Tree-girdling mice inflicted great damage to orchard trees and nursery stock in some sections, though this was curtailed markedly in eastern areas where control has been practiced during the past few years. Widespread and in many instances severe depredations by the common rat varied greatly, from the contamination and destruction of stored food supplies and crops to gnawing of insulation from electric wires and cables. The kangaroo rat has been a major factor in depleting range forage on many western grazing areas, and through its seed-gathering habits this rodent tends to reduce the natural reseeding of range lands. One observer in charge of a reseeding project in New Mexico stated that his men could gather more valuable grass seeds from kangaroo rat dens in a day than they could in a week from the mature grass on the range.

The extent of rodent damage has led States, counties, municipalities, farm organizations, and others to increase their financial support to cooperative programs. Rodent control was also conducted through the medium of C. C. C. camps in cooperation with various governmental agencies. A number of W. P. A. projects also were instituted under trained leadership for the control of rodents to protect crops, range lands, soil-conserving structures, and silvicultural plantings. In numerous campaigns throughout the country the Survey cooperated with States, counties, cities, civic organizations, and State and local health departments for the suppression of the common house rat. On areas that had been treated for the eradication of field rodents in previous years, control was maintained through policing to prevent reinfestation.

Rodents and Communicable Diseases

New cases of sylvatic plague carried by rodents were reported for the following animals: Prairie dogs, in Sweetwater County, Wyo.; ground squirrels, in Fremont County, Idaho; Spokane County, Wash.; Wallowa County, Oreg.; and Elko County, Nev.; golden-mantled ground squirrels, in Eldorado County, Calif.; and rabbits, in Lincoln County, Wash.

In the lower Rio Grande Valley, Tex., cases of typhus fever increased alarmingly, 120 having been reported from Hidalgo County and 100 from Cameron County. In Kleberg County, where two deaths were reported, the disease was so prevalent that entire fam-

ilies avoided theaters and other public gatherings. To reduce the infection, rat control was instituted in these areas.

A project was inaugurated in Pierce County, N. Dak., in cooperation with the State Health Department, to suppress an epizootic of rabies, where rats had become infected and were partly responsible for its spread. A study was begun, in cooperation with the Food and Drug Administration of the United States Department of Agriculture, to determine the influence of rats in spreading the organism responsible for food poisoning.

Instances of Rodent and Rabbit Damage

Rabbits.—In the Kearney district and adjacent areas in Nebraska an exceptionally dry summer and fall caused especially severe jack rabbit damage. On individual farms, losses of as much as 30 acres in fall wheat were sustained and whole fields of clover and alfalfa were literally dug out. Jack rabbits defeated a project for the stabilization of sand dunes in Bent County, Colo., by completely destroying plantings made to obtain a stand of sod. In a nursery at Yankton, S. Dak., cottontail rabbits caused $3,000 damage by girdling 5,000 apple trees.

Pocket gophers.—In Star Valley, western Wyoming, pocket gophers consumed an 80-acre field of dry-land alfalfa, making plowing and reseeding necessary. The cost of establishing the original stand was $5 an acre. In requesting pocket gopher control work, the vice president of the Valley Land Co., at Malaga, N. Mex., wrote that the company was annually threatened with disastrous washouts in the main canal, caused by pocket gophers undermining the bottom and sides, and that repairs after several such washouts had cost thousands of dollars.

Other rodents.—Rat damage in rural sections of Crawford County, Ill., was reported by officials to amount to $25,000 during the year. In rural sections of the North Central States the damage from rat infestations reached an all-time high during the fall of 1939. One fruit grower in the vicinity of Dupont, Ind., reported that field mice girdled 600 fruit trees, the greater proportion of which died as a result. Many growers in the fruit sections of the North Central States lost 25 to 150 trees in individual orchards through the depredations of field mice. Girdling by porcupines destroyed more than half a planting of red spruce near Cabot, Vt.

Benefits of Rodent Control

Following are a few of the typical benefits derived from the control of economically injurious rodents.

Pocket gopher control conducted on Reclamation Service projects in El Paso County, Tex., during the past 5 years has reduced the water loss 70 percent. The previous extremely heavy water losses were occasioned by leakage and washing through pocket gopher tunnels, but during the past year there have been no major breaks in canals or laterals. The carrying capacity of range lands in Chavez and Eddy Counties, N. Mex., has been increased 50 percent following prairie dog control conducted a few years ago. Of the 37,999 premises treated in a cooperative control campaign in the North Central States during the fall, 47 percent were free from rats after the first baiting, thus resulting in material savings to stored feed.

WILDLIFE CONSERVATION IN ALASKA

CHANGES IN REGULATIONS

The 1940–41 regulations under the Alaska game law, published in Circular AGC–18, the first to be issued by the Secretary of the Interior since the transfer of this function from the Secretary of Agriculture, contained few changes of material importance. A closed season is provided on martens throughout the Territory and on all fur animals in fur district 1, embracing southeastern Alaska. Beavers may be taken in fur districts 2, 4, 5, and 6, and the limit is 10 to each trapper. Open-season dates on other fur animals were adjusted.

A uniform season throughout the Territory was fixed on caribou, with a limit of 3 for residents and 2 for nonresidents. Shooting these animals is prohibited in an area 1 mile wide on either side of Steese Highway between mileposts 69.8 and 116. Moose are given added protection in a closed area half a mile on either side of all public highways in the First and Third Judicial Divisions. The seasons on mountain goat and mountain sheep were each shortened 15 days. On grouse and ptarmigan they were advanced to August 20 and the limits reduced to 10 grouse and 15 ptarmigans and an aggregate limit of 15. Black bears are afforded protection in the Loring area, and all species on sanctuaries, including the Wrangell-Shoemaker area on Wrangell Island and the Haines area embracing the drainage of the Klahini River.

For the first time in its history the Alaska Game Commission held its annual meeting elsewhere than at Juneau, and much favorable comment resulted. It met at Anchorage late in February with a twofold purpose: To make it possible for residents of that area to appear before the Commission to express their views on the regulations and for all the wildlife agents to be present.

LAW ENFORCEMENT

The use of airplanes has added materially to the effectiveness of law enforcement in Alaska, and one 2-place cabin airplane was purchased for service out of Fairbanks and two 4-place machines were ordered for early delivery. Wildlife agents were assigned to Sitka and to Kodiak Island. Cases of unusual importance successfully terminated by the Alaska Game Commission included the prosecution of two fur dealers who were fined $500 and $750, respectively, in the United States District Court at Ketchikan for failure to keep proper records; the seizure of 150 extra-large illegal beaver skins, currently valued at about $4,000; and the apprehension in the remote Mount Hayes district, by aid of an airplane, of one of the worst game offenders ever known to the Commission. In this case, the agents seized the meat of 21 game animals, including 11 mountain sheep, 1 lamb, 2 cow moose, and 7 caribous; discovered 34 ram horns under a tree, most of which represented fresh kills; and found that the violator had fed mountain sheep to his dogs. Pleading guilty, the violator was fined $150 and sentenced to jail for 5 months.

For the 246 violations reported, 32 of which involved aliens, fines aggregated $6,985 and jail sentences, 3,148 days. The 381 furs seized included pelts of 202 beavers, 61 minks, 22 martens, 17 red foxes, 6 cross foxes, 11 blue foxes, 4 white foxes, 16 lynxes, 28 weasels, 8 otters, 3 wolverines, 1 wolf, and 2 coyotes. Deer, moose, mountain sheep, and caribou meat seized weighed 2,167 pounds. Other seizures included 1 brown and 1 grizzly bear, 178 traps, 26 resident hunting licenses, 58 firearms, and 1 duck stamp. The estimated value of the confiscated furs and traps was $7,105.50.

WILDLIFE RESTOCKING PROJECTS

Some 800 pheasant eggs, obtained through the cooperation of the Washington State Game Department, were hatched at the Territorial experimental station at Petersburg, in the vicinity of which also several broods of pheasants were hatched in the wild. In the Wrangell Reserve area, 150 Mongolian pheasants were liberated and 100 are to be shipped to the Kenai Lake area in July, the first pheasant-stocking projects in these districts. Most of the pheasants received from the Wisconsin State Conservation Department last year, consisting of eared (blue and brown), Cheer, Reeves, and Kaleege varieties, wintered fairly well and laid eggs.

On Kodiak Island, beavers, muskrats, and snowshoe hares have increased splendidly, and the restocking projects there are reported to be doing exceptionally well. The 8 elk placed on Afognak Island in 1927 have increased until now there is one herd of 100-odd animals

and smaller herds, possibly of 50 to 75 each. The 19 buffaloes transplanted from Montana to the Big Delta area near Fairbanks in 1928 have increased to nearly 200. Several bands have resulted from the 18 mountain goats transferred from the mainland near Juneau to Baranof Island near Sitka, one of which it is estimated consists of 75 animals, and there are possibly 200 animals in all. Musk oxen transplanted in the Nunivak Island Wildlife Refuge are reported to number more than 90.

PREDATOR CONTROL

One predatory-animal hunter took a count during the winter of the wolves and coyotes in the Mount Hayes area, where more have been taken than in previous years, and studied their effect on game animals. All claims for the Territorial $20 bounty on both animals are required by law to be certified by agents of the Alaska Game Commission, a proviso that has resulted in a considerable saving in avoiding payment of fraudulent claims.

BIOLOGICAL INVESTIGATIONS

Field research included a study of spring calving of the Kenai moose, a range and wildlife survey of the Matanuska-Susitna Valley, an investigation of the buffaloes in the interior, and continuation of Kodiak bear-cattle investigation. A few brown bears, said to have been stock killers, were taken under permit. Few kills by the bears were reported, and with the situation apparently well in hand, further damage should be negligible. A visit was made to Mount McKinley National Park for cooperation with the National Park Service in a study of wolf-mountain sheep relationships.

The range and wildlife survey of Matanuska-Susitna Valley was begun as part of a cooperative soil and land-use survey, and the preliminary reconnaissance indicated that (1) the woodland valley range of the immediate colony unit is generally of low grazing capacity and may be improved by clearing and seeding to bluegrass, fescue, wheatgrass, Dutch clover, and other cultivated forage species; (2) the mountain ranges are suitable for grazing livestock, and the estimated capacity for a 4-month summer season is 21,000 cattle and 60,000 sheep; (3) the area has an abundant wildlife population; (4) the present take of moose, sheep, and mountain goats is not excessive and may be continued; and (5) fishing furnishes the chief means of livelihood for 1,332 residents about Cook Inlet.

ALASKAN BIG GAME

The Alaska Game Commission estimates that more than a million big-game animals range over the Territory's wilderness areas. About 42,000 Sitka black-tailed deer are to be found in the humid southeastern

part of Alaska. Moose are particularly abundant on the Kenai Peninsula and in Rainy Pass. The caribou is still the most abundant big-game animal in Alaska, even though its numbers have been reduced. Once this animal moved across the Alaskan tundras in spectacular massed migrations that included herds of thousands of animals in areas where now there are only hundreds. In an effort to halt further decline, stricter regulations have been adopted and closed areas have been established along the highways, where these animals may be free to cross without being subjected to hailstorms of lead from passing motorists. Mountain sheep and mountain goats are maintaining their numbers and doing well. The various bears are more than holding their own—the grizzlies show little if any fluctuation; black bears are plentiful; the big brown bears show definite signs of increasing numbers; and in the far north the great white polar bears are more numerous than for a decade. Big-game hunters shipped out 217 trophies during the year, nonresident and alien hunters accounting for 134 animals and resident exporters for 83. Included were 39 moose, 35 mountain sheep, 8 mountain goats, 20 caribou, 11 deer, 73 large brown and grizzly bears, and 31 black bears.

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